

TRANSISTORISED H. F. RECEIVER

TYPE RA. 222 A1

(Serial Nos. 51-250)

nr- 202

Operating and Maintenance Manual

Technical Handbooks Department

RACAL COMMUNICATIONS LIMITED

Western Road,
Bracknell, Berkshire,
England.

DANGER

LETHAL VOLTAGES

*Although every reasonable precaution has been observed
in design to safeguard operating personnel
this warning is . . .*

VITAL !

ADJUSTMENTS

EXERCISE GREAT CARE

DO NOT ADJUST ALONE

If possible, when making adjustments, ensure the presence of another person capable of rendering aid.

SERVICING

SWITCH OFF

**DO NOT TAMPER
WITH INTERLOCKS**

Only authorised personnel should be allowed to remove or neutralise the effect of interlocks. Do not rely on interlock switches for protection.

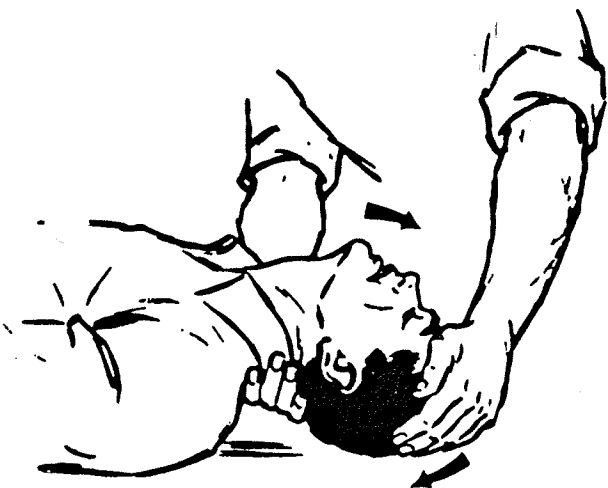
DO NOT SERVICE ALONE

If possible, when servicing, ensure the presence of another person capable of rendering aid.

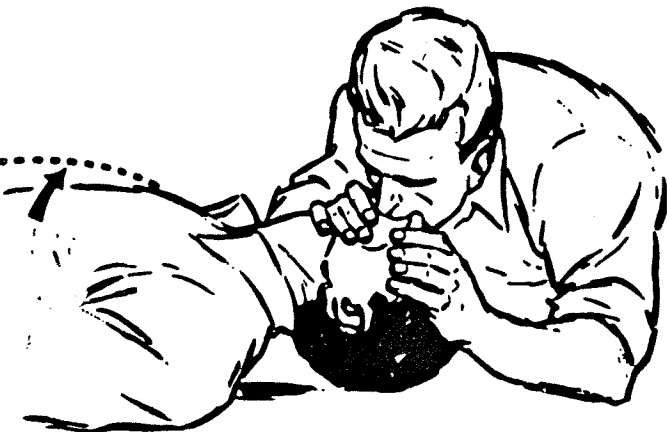
SEE OVER FOR RESUSCITATION INSTRUCTIONS

FIRST AID

in case of Electric Shock



1. Lay victim on his back.
2. Clear victim's mouth and throat.
3. Tilt victim's head back as far as possible and raise his head.



4. Pinch victim's nostrils.
5. Take a deep breath.
6. Cover the victim's mouth with yours and blow, watching his chest rise. Note: Blow forcefully into adults, but gently into children.
7. Move your face away to allow victim to breathe out, watching his chest fall.
8. Repeat first five to ten breaths at a rapid rate; thereafter, take one breath every three to five seconds.
9. Keep victim's head back as far as possible all the time.

Have someone else send for a Doctor

Keep patient warm and loosen his clothing

**DO NOT Give liquids
until patient is conscious**

HANDBOOK CHANGE INFORMATION

At RACAL, we continually strive to keep up with the latest electronic developments by adding circuit and component improvements to our equipments.

Sometimes, due to printing and despatch requirements, we are unable to incorporate these changes immediately into printed handbooks. Hence, your handbook may contain new change information on following pages.

The user is recommended to hand-amend this handbook, as soon as possible, in accordance with the corrections, if any, which follow this sheet.

NOTES

C O R R I G E N D A

COMPONENTS LIST

The following capacitors appear in a number of modules in the receiver. These capacitors are becoming obsolete, but will be fitted during production whilst stocks last. When the present stocks of these capacitors are exhausted the manufacturer will use the replacement items detailed below. To expedite spare part orders please quote the replacement capacitor.

.047 μ F Plastic Film 30V \pm 20%	Mullard C280AA/P47K
Replaced by: -	
.047 μ F Plastic Film 250V \pm 20%	Mullard C280AE/P47K
.01 μ F Plastic Film 30V \pm 20%	Mullard C280AA/P10K
Replaced by: -	
.01 μ F Plastic Film 250V \pm 20%	Mullard C280AE/P10K
0.1 μ F Plastic Film 30V \pm 20%	Mullard C28AA/P100K
Replaced by: -	
0.1 μ F Plastic Film 250V \pm 20%	Mullard C280AE/P100K
25 μ F Electrolytic 25V	Mullard C426AM/F25
Replaced By: -	
25 μ F Electrolytic 25V	Mullard C426AR/F25
64 μ F Electrolytic 25V	Mullard C426AM/F64
Replaced by: -	
50 μ F Electrolytic 25V	Mullard C426AR/F50
100 μ F Electrolytic 16V	Mullard C426AM/E100
Replaced by: -	
125 μ F Electrolytic 16V	Mullard C426AR/E125

Channel Osc. and Crystal Over

Add: -

3C16 & 17	2.2pF Ceramic P100 750V \pm $\frac{1}{2}$ pF 5910-99-011-8340	Erie P100-A
3C18	0.1 μ F Plastic Film 250V \pm 20%	Mullard C280AE/P100K

I.F. Amplifier

Add: -

2C57 47pF Polystyrene 125V \pm 2 pF Salford PF

3 Mc/s Carrier Re-Insertion Osc.

5D1 Change Manufacturer's type to Hughes HC 7001

A.F. Unit

4C20 Deleted

A.C. Powered Unit

Add: -

6FS3 Fuse Cartridge Belling Lee L562
 Fuse Holder Belling Lee L575

Extended Control Module, MA. 346

Add: -

9MR3 Silicon Junction Diode Texas IS113
9VT1 Silicon PNP Transistor Texas 2S324
9R1 33 Ω Carbon Resistor 1/10W \pm 10% Erie 15
9R2 4.7k Ω Carbon Resistor 1/10W Erie 15
 \pm 10%
9R3 2.7k Ω Carbon Resistor 1/10W Erie 15
 \pm 10%

Pre-Set Carrier Re-Insertion Osc.

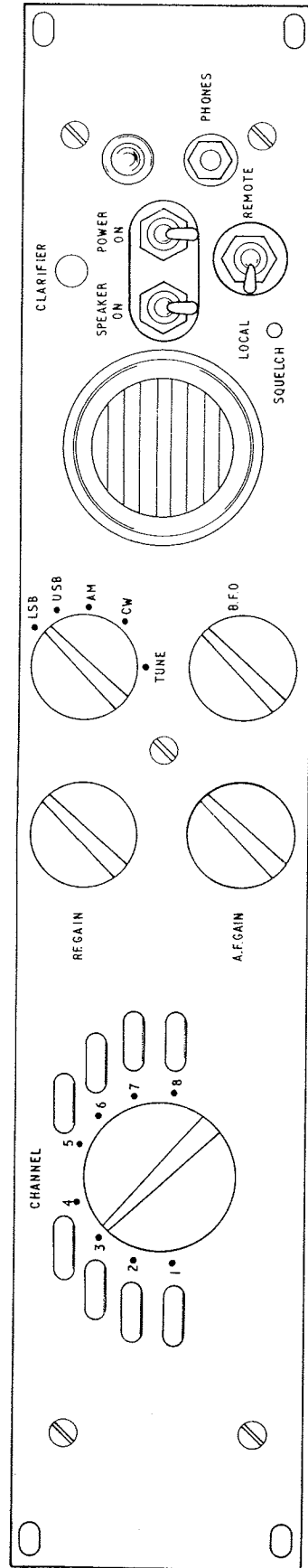
Add: -

5C13 47pF Polystyrene 125V \pm 2 pF Salford PF

ILLUSTRATIONS

Figs 2 and 4 Change IR17 on Range 3 board to 6.8K
Figs 5 and 6 Add 3C16 2.2pF in parallel with 3R5
 Add 3C17 2.2pF in parallel with 3R10
 Add 3C18 0.1 μ F from -24V line to Earth line on Fig 6.

- Add 3C18 to bottom of mounting board opposite 3C14 and 3C15 on Fig 5.
- Figs 7 and 8 Add 2C57 47pF from junction of 2R1 2R2 to the junction of 2R9 2R10.
- Fig 10 Change 5D1 from HC 7002 to HC 7001
- Figs 13 and 14 Delete capacitor 4C20
On fig 14 change value of 7C3 on Squelch unit to 50 μ F and reverse polarity of 4C10.
- Fig 16 Change value of 6C3 to 50 μ F
Add fuse 6FS3 (250 mA) between 6C7 and switch 6SA in L lead at a. c. power input.
- Fig 18. Change value of 12C3 to 50 μ F
- Fig 20 Change value of 13C3 to 50 μ F
- Fig 25b Reverse polarity of 4C10 and delete 4C20 in the Audio Amplifier.
- Figs 26 and 27. Add 5C13 47pF from junction of 5R1, 5R2 to the junction of 5R9, 5R10.



Transistorised H.F. Receiver Type R.A 222

157/26

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TECHNICAL SPECIFICATION

Frequency Range:	1.5 to 24 Mc/s.
Number of Channels:	Eight (switched).
Frequency Bands:	Any selection from the ranges: 1.5 to 3.25 Mc/s, 3.25 to 7 Mc/s, 7 to 14 Mc/s and 14 to 24 Mc/s.
Types of Reception:	SSB (suppressed or reduced carrier) DSB MCW CW (optional).
RF Input Impedance:	75 ohms (unbalanced).
Sensitivity:	1 μ V input for 50 mW output.
Signal-to-Noise Ratio:	SSB: 12 dB for 1.5 μ V input DSB: 10 dB for 4 μ V input CW: 12 dB for 1.5 μ V input.
Stability:	Stable within 25 c/s for temperature changes of up to 10 degrees C.
Sidebands:	Upper or Lower (switched).
Selectivity (6 dB points):	SSB: 3.5 kc/s DSB and CW: 8 kc/s.
Image Rejection:	Normally 60 dB, minimum 50 dB.
Channel Crystals:	1.5 to 7 Mc/s: Channel frequency plus 700 kc/s. 7 to 14 Mc/s: Channel frequency plus 3 Mc/s. 14 to 24 Mc/s: Channel frequency minus 3 Mc/s. Style: British Style D. American Type HC-6/U. Oven Temperature: 60 degrees C.
Clarifier Range:	150 c/s
AGC Characteristics:	For 60 dB increase in RF input, the AF output does not increase by more than 6 dB.
Muting:	Aerial and AF switching operated by a loop of up to 500 ohms.

AF Outputs:	<ul style="list-style-type: none"> (a) 500 mW into 15 ohms loudspeaker. (b) 4 or 10 mW into 2000 or 600 ohms (headphone jack). (c) 10 mW into 600 ohms (pre-set for an external line, balanced or unbalanced).
AF Distortion:	Less than 5% at 500 mW output.
Optional Extra Facilities:	<ul style="list-style-type: none"> (a) CW: BFO range ± 3 kc/s. (b) Squelch: Threshold adjustable from less than 10 mW to greater than 250 mW.
Extended Control Facilities: (Optional) (in conjunction with LA. 370)	<ul style="list-style-type: none"> (a) Channel selection and Stand By position. (b) Clarifier control. (c) BFO control. (d) RF gain control. (e) AF gain control of LA. 370 amplifier. (f) LA. 370 incorporates a loudspeaker and has a phone jack output.
Power Supply:	<ul style="list-style-type: none"> (a) 100 to 125 V and 200 to 250 V a.c. at 45 to 60 c/s. (b) 24 V d.c. (nominal). (c) 12 V d.c. (nominal).
Power Consumption:	Average 14 watts. Maximum 25 watts.
Climate and Durability:	Suitable for temperatures from -10 degrees C to +50 degrees C
Dimensions:	3½" high x 19" wide x 13" deep. (8.9 cm) (48.3 cm) (33 cm)
Weight:	16 lbs. (7 kg.) approximately.

24 Volt d.c. Powered

RA. 222N	SSB, AM and CW reception.
RA. 222P	SSB, AM and CW reception with squelch control fitted.
RA. 222Q	SSB, AM and CW reception with extended control module MA. 346 fitted.
RA. 222R	SSB, AM and CW reception with squelch and extended control module MA. 346 fitted.

7. In the receiver versions with squelch control facilities, the squelch unit breaks the audio output from the a.f. amplifier under poor signal conditions. The signal level at which this control will function can be determined by the operator.
8. The receivers with extended control facilities have the MA. 346 control unit as an additional module. At the extended control point, the receiver is controlled by the Extended Control Unit type LA. 370 to provide Channel selection with a Stand By position, RF gain, Clarifier and BFO control. The LA. 370 includes an independant audio amplifier with gain control, an internal loudspeaker and a headphone jack.
9. The receiver version covered by this handbook has SSB, DSB, CW, Squelch and extended control facilities and includes details of each of the power units in the applicable chapters.

CHAPTER 1

GENERAL DESCRIPTION

BRIEF DESCRIPTION

1. The H. F. Receiver Type RA. 222 is a fully transistorised unit that has been designed for operation in SSB and DSB radio systems with the Racal range of SSB transmitters and radio telephones. Receiver muting is available from connections at the rear of the receiver for when it is in close proximity to a transmitter.
2. Eight crystal controlled channels are available covering the frequency range of 1.5 to 24 Mc/s. All r.f. circuits are pre-tuned plug-in units and channel selection is by means of an eight position rotary switch. The eight channel crystals operate in a thermostatically controlled oven.
3. Switched selection is available for upper or lower sideband on SSB, and DSB or CW operation.
4. The audio output circuit feeds an internal speaker, an external loud-speaker terminal at the rear of the receiver, a headphone jack socket on the front panel and a line output at 600 ohms impedance.
5. The unit is of robust construction and suitable for bench or 19 inch rack mounting.

VARIANTS

6. Alternative power supply models are produced for use on a.c. power, 12 volt and 24 volt d.c. supplies. In addition there are four versions available for operation from each of these power supplies with facilities as detailed below:-

A. C. Powered

RA. 222A	SSB, AM and CW reception.
RA. 222B	SSB, AM and CW reception with squelch control fitted.
RA. 222C	SSB, AM and CW reception with extended control module MA. 346 fitted.
RA. 222D	SSB, AM and CW reception with squelch and extended control module MA. 346 fitted.

12 Volt d.c. Powered

RA. 222G	SSB, AM and CW reception.
RA. 222H	SSB, AM and CW reception with squelch control fitted.
RA. 222J	SSB, AM and CW reception with extended control module MA. 346 fitted.
RA. 222K	SSB, AM and CW reception with squelch and extended control module MA. 346 fitted.

CHAPTER 2

INSTALLATION AND SETTING-UP

INITIAL PROCEDURE

1. After carefully unpacking the receiver, remove the cover and inspect for any transit damage. Ensure that no packing remains within the unit, that the crystals and 'r.f. plug-in boards' are firmly in place and that the link plug at the rear of the receiver is in the INT. LS. position.

WARNING: Under no circumstances should the receiver be installed in a position where the ambient temperature of the surrounding air will exceed 50°C. This is also the maximum permissible air temperature in an equipment mounting rack.

POWER SUPPLIES

A. C. Powered Unit

2. Ensure that the rating of the h.t. fuses on the power unit chassis are correct viz. 1 amp.
3. Adjust the voltage selector to the appropriate position for the supply voltage in use and connect to the supply.

24 V D.C. Powered Unit

4. Ensure that the polarity of the supply is correctly connected and that the rating of the fuses in the filter unit are rated at 2.5 amps.
5. Two spade terminal units on the filter unit provide adjustment of the earthed supply as follows:-
 - (1) For a supply with the positive earthed, connect the spade terminal unit with the red leads to the pair of screw terminals adjoining the supply terminals and the spade terminal unit with the black lead furthest away. See figure 2.1.
 - (2) For a negative earthed supply, the spade terminal units are in the reverse positions to those detailed in paragraph (1).

NOTE: The receiver chassis polarity will be identical to that selected on the filter unit.

6. Check that the h.t. fuses installed in the power unit chassis are rated at 1 amp.

12 V D.C. Powered Unit

7. Check that the polarity of the supply is correctly connected and that the fuses on the inverter are rated at 2.5 amps.
8. For an earthed positive supply, a link must be connected in between the E and positive terminal of the supply terminal strip on the inverter unit.

In the case of a negative earthed supply, the link is connected across the negative and E terminals. See figure 2.2.

9. Examine the h.t. fuses on the power unit chassis to ensure that they are rated at 1 amp.

AERIAL MUTING

10. The muting terminals at the rear of the receiver are to be connected by a loop of up to 500 ohms to the appropriate terminals on a transmitter, if the receiver is installed in the proximity of the transmitter.

EXTERNAL LINE OUTPUT

11. The line output can be either balanced or unbalanced and is suitable for 600 ohm operation. Balanced line output can be obtained by applying an earth to the centre terminal of the line output. Adjustment of the output level is set by the pre-set potentiometer 4RV4 in the amplifier section (see fig. 24 for control location).

PRELIMINARY SETTING-UP

12. Switch on the receiver by means of the POWER switch and connect the aerial to the co-axial socket at the rear of the receiver. Allow at least an hour for the channel crystals in the oven to stabilise and set the controls as follows:-

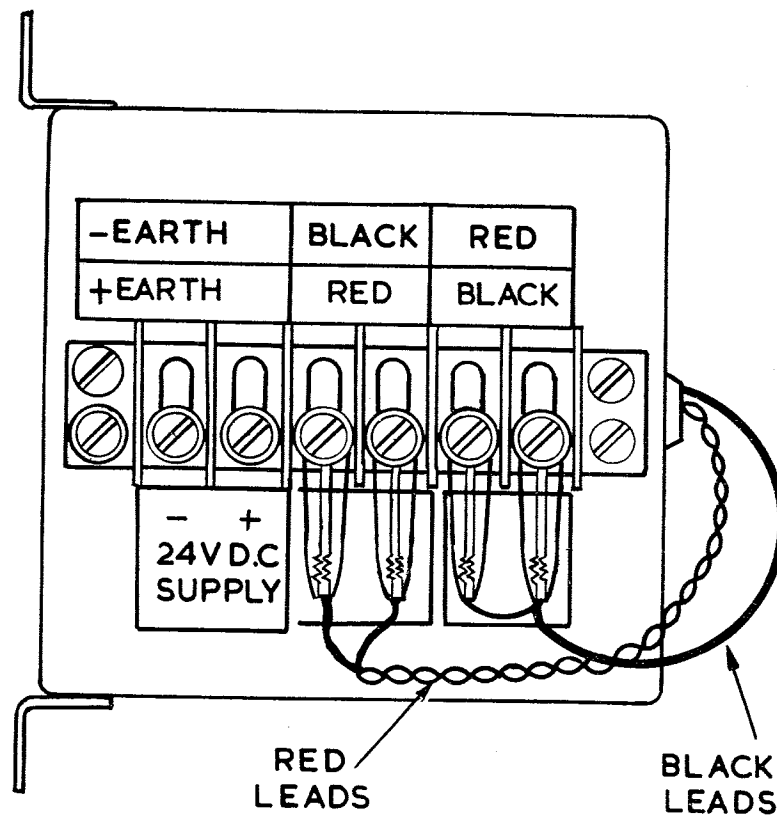
RF GAIN to maximum (extreme clockwise position)
AF GAIN to maximum (extreme clockwise position)
System switch to TUNE
SPEAKER switch to ON
Adjust SQUELCH pre-set control (if fitted) to extreme clockwise position
LOCAL-REMOTE switch in the LOCAL position
CLARIFIER control with knob indication in a vertical position (if fitted)

IMPORTANT NOTE The CLARIFIER control has a range of 150 c/s and should not be adjusted during this procedure. Correct frequency operation is obtained by adjustment of the appropriate channel oscillator trimmer.

13. Select Channel 1 on the CHANNEL switch and with the aid of a trimming tool, the channel crystal frequency is adjusted on a pilot carrier by setting the concentric trimming capacitor 3C5 (see fig. 24 for trimmer locations) for a zero beat output on the loudspeaker.

14. Repeat the procedure in paragraph 13 for Channels 2 to 8 adjusting the following trimming capacitors:-

Channel 2 adjust capacitor 3C6
Channel 3 adjust capacitor 3C7
Channel 4 adjust capacitor 3C8
Channel 5 adjust capacitor 3C9
Channel 6 adjust capacitor 3C10



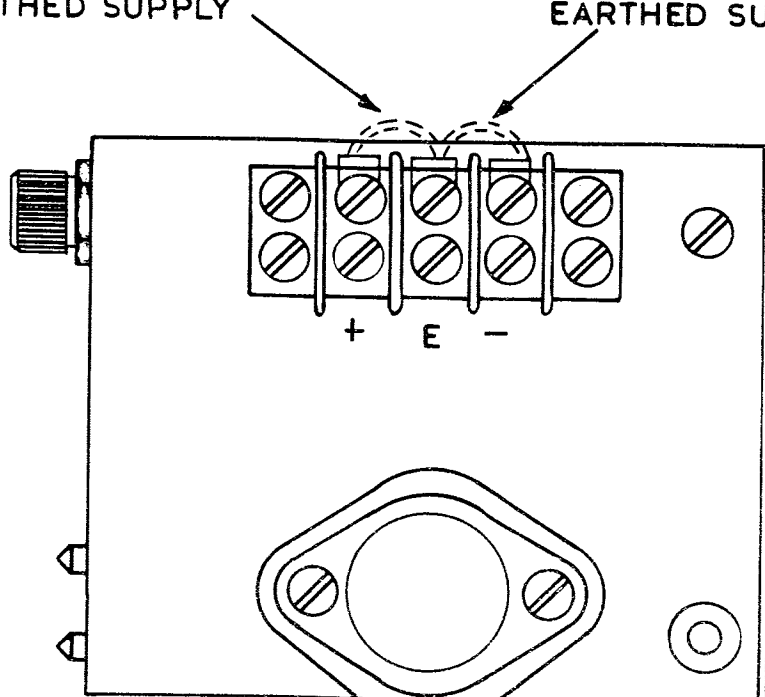
NOTE:

LEADS AS SHOWN FOR A POSITIVE EARTHED SUPPLY,
FOR A NEGATIVE EARTHED SUPPLY THE POSITIONS
OF THE RED AND BLACK LEADS ARE REVERSED.

24Volts d.c. Supply Connections. Fig.2.1

LINK FOR POSITIVE
EARTHED SUPPLY

LINK FOR NEGATIVE
EARTHED SUPPLY



12 Volt d.c. Invertor Supply Connections

Fig.2.2

Channel 7 adjust capacitor 3C11

Channel 8 adjust capacitor 3C12

15. Monitor the a.g.c. voltage with the Avo Model 8 connected to the A.G.C. CHECK point, see Figure 3 for location. Select each channel in turn and adjust the trimmer capacitors (see fig. 2) on each respective plug-in board for minimum obtainable meter deflection. Figure 23 shows the positions of the plug-in boards for Channels 1, 2, 7 and 8 and figure 24 shows the board positions for Channels 3, 4, 5 and 6. The receiver will now be accurately tuned for each channel.

NOTE: Coil cores on the plug-in boards are not to be adjusted. See Section 2, Chapter 5, Paragraph 14 to change the frequency of a channel.

EXTERNAL LOUDSPEAKER

16. A 15 ohms impedance speaker may be used for external purposes and should be connected to the EXT. L.S. OUTPUT terminals at the rear of the receiver. The link plug adjoining the terminals is then transferred from the INT. L.S. position to the EXT. L.S. position when the external loudspeaker is required.

NOTE: Always select the OFF position on the SPEAKER switch before removing the INT. - EXT. L.S. link plug.

EXTENDED CONTROL

17. Extended control may be operated on lines by a loop of up to 500 ohms and capable of carrying 50 mA plus the lamp current, for the extended control receiver versions.
18. Insert the 15 pole plug, terminating the connector from the extended control position, into the socket at the rear of the receiver.

CHAPTER 3

OPERATING INSTRUCTIONS

1. Before operating the receiver, it should first have been installed and set-up as described in Chapter 2 in this section. The operation of the receiver is described in this chapter for the individual reception positions of the System switch.

NOTE: To change the frequency of a channel see Section 2, Chapter 5, paragraph 14 for the procedure to be adopted.

L. S. B. OPERATION

2. (1) Select the L. S. B. position on the System switch and switch on the receiver at the POWER switch. Allow at least 30 minutes for the channel crystals to stabilise in the oven. Normal AM reception is possible during this period, CW and SSB operation will suffer due to some frequency drift. After the initial warming up period of the crystal oven, subsequent warming up periods can be dispensed with on the extended control versions (fitted with MA. 346 modules) by selecting the ninth position on the CHANNEL switch when receiver reception is not required. This position of the CHANNEL switch is equivalent to the STAND BY position on the LA. 370 Extended Control Unit and will apply the supplies to the crystal oven and MA. 346 only in the receiver.

IMPORTANT NOTE: The CLARIFIER control has a range of 150 c/s and should only be re-adjusted to compensate for when frequency drift occurs between the transmitter and receiver. The control should be set to zero with the white dot line vertical.

- (2) Select the desired channel on the CHANNEL switch.
- (3) Set the SPEAKER switch to ON, select the LOCAL position of the LOCAL-REMOTE switch and the AF GAIN control to its maximum position.
- (4) Adjust the RF GAIN control to the lowest setting which gives adequate output i. e. freedom from fading etc.
- (5) The speaker in the receiver may be switched off if desired and suitable headphones (600Ω for 10mW or 2000Ω for 4mW) plugged into the jack socket on the front panel. Reduce the AF GAIN control as required.
- (6) If the receiver has Squelch facilities, rotate the pre-set SQUELCH control so that the speaker or headphones are muted in the absence of an intelligible signal i. e. when the signal-to-noise ratio falls below the desired quality. With careful adjustment signals a few dBs above the noise suffice to switch the speaker etc. on.

- (7) The RF GAIN and CLARIFIER controls need only be re-adjusted to compensate for gross variation in signal conditions during the period of operation.
- (8) For the receiver versions provided with extended control facilities, the REMOTE position of the LOCAL-REMOTE switch may now be selected and the receiver controlled by the RF GAIN, CHANNEL and CLARIFIER controls on the LA. 370.

U. S. B. OPERATION

3. Select the USB position on the System switch and switch the receiver on. The remaining operational procedure is identical to that already described in paragraphs 2 for L. S. B. operation.

A. M. OPERATION

4.
 - (1) Set the System switch to AM position and switch 'on' the receiver by means of the POWER switch.
 - (2) Set the CHANNEL switch to the desired channel.
 - (3) Switch the SPEAKER to ON, select the LOCAL position of the LOCAL-REMOTE switch and the AF GAIN control to its maximum position.
 - (4) Adjust the RF GAIN control to the lowest setting which gives adequate output i. e. freedom from fading etc.
 - (5) The speaker in the receiver may be switched off if desired and suitable headphones ($600\ \Omega$ for 10 mW or $2000\ \Omega$ for 4 mW) plugged into the front panel socket. Reduce the AF GAIN control as required.
 - (6) If the receiver has Squelch facilities, rotate the pre-set SQUELCH control so that the speaker or headphones are muted in the absence of an intelligible signal i. e. when the signal-to-noise ratio falls below the desired quality. With careful adjustment signals a few dBs above the noise suffice to switch the speaker etc. on.
 - (7) The RF GAIN control need only be re-adjusted to compensate for gross variation in signal strength during the period of operation.
 - (8) For the receiver versions provided with extended control facilities, the REMOTE position of the LOCAL-REMOTE switch may now be selected and the receiver controlled by the RF GAIN and CHANNEL controls on the LA. 370.

C. W. OPERATION

5.
 - (1) Adjust the System switch to the CW position and switch the receiver 'on' at the POWER switch. Allow at least 30 minutes for the channel crystals to stabilise in the oven. Normal AM reception is possible during this period, CW and SSB operation will suffer due to

some frequency drift. After the initial warming up period of the crystal oven, subsequent warming up periods can be dispensed with on the extended control versions (fitted with MA.346 modules) by selecting the ninth position on the CHANNEL switch when receiver reception is not required. This position of the CHANNEL switch is equivalent to the STAND BY position on the LA.370 Extended Control Unit and will apply the supplies to the crystal oven and MA.346 only in the receiver.

- (2) Select the desired channel on the CHANNEL switch.
- (3) Set the SPEAKER switch to ON, the LOCAL-REMOTE switch in the LOCAL position, the RF and AF GAIN controls to maximum.
- (4) Set the BFO control to the desired frequency pitch.
- (5) Rotate the RF GAIN control to the lowest setting which gives adequate output i. e. freedom from fading etc.
- (6) The receiver loudspeaker may be switched 'off' if desired and suitable headphones (600Ω for 10 mW or 2000Ω for 4 mW) plugged into the front panel jack socket. Reduce the AF GAIN control as required.
- (7) If the receiver is provided with Squelch facilities, adjust the pre-set SQUELCH control so that the speaker is muted in the absence of an intelligible signal i. e. when the signal-to-noise ratio falls below the desired quality. With careful adjustment signals a few dBs above the noise suffice to switch the speaker etc. on.
- (8) The RF GAIN need only be adjusted now to compensate for gross variation in signal strength during the period of operation.
- (9) For the receiver versions provided with extended control facilities, the REMOTE position of the LOCAL-REMOTE switch may now be selected and the receiver controlled by the RF GAIN, BFO and CHANNEL controls on the LA.370.

CHAPTER 4

PRINCIPLE OF OPERATION

INTRODUCTION

1. Reference should be made to figure 1 for the purpose of this chapter.
2. The receiver operates as a double superheterodyne for the frequency range between 1.5 and 7 Mc/s with a first intermediate frequency of 700 kc/s and a second intermediate frequency of 3 Mc/s. For the frequency range from 7 to 24 Mc/s the receiver becomes a conventional superheterodyne with a single intermediate frequency of 3 Mc/s.

RF AMPLIFIER

3. The aerial input circuit to the r.f. amplifier takes the form of a band-pass filter that is pre-tuned to a desired signal frequency in the range from 1.5 to 24 Mc/s. The output from this filter is amplified by the r.f. amplifier and fed to a second band-pass filter that is also tuned to the signal frequency. These two filters form the major part of a r.f. plug-in board. There is a separate plug-in board for each channel on the receiver.

FIRST MIXER AND CHANNEL OSCILLATOR

4. The output from the second band-pass filter in the r.f. amplifier stage is fed into the input of the first mixer.
5. The first mixer produces an intermediate frequency output at 700 kc/s when the receiver is operating at signal frequencies between 1.5 and 7 Mc/s and an output at 3 Mc/s when it is operating at signal frequencies from 7 to 24 Mc/s. This is achieved by mixing the signal frequency (f_s) from the r.f. amplifier and the channel oscillator frequency (f_o) to produce the relevant intermediate frequency output.
6. The channel oscillator output (f_o) is at the signal frequency (f_s) plus 700 kc/s when the receiver is at frequencies below 7 Mc/s, and for signal frequencies between 7 to 14 Mc/s, the oscillator output (f_o) is at the signal frequency (f_s) plus 3 Mc/s. Above 14 Mc/s the oscillator output (f_o) will be the signal frequency minus 3 Mc/s.

3.7 MC/S OSCILLATOR AND SECOND MIXER-BUFFER AMPLIFIER

7. The 3.7 Mc/s oscillator and second mixer convert a 700 kc/s output from the first mixer to an output of 3 Mc/s for amplification by the 3 Mc/s i.f. stages. When there is a 3 Mc/s output from the first mixer, the second mixer

becomes a buffer amplifier and the 3.7 Mc/s oscillator is rendered inoperative. The changeover is by a relay controlled from links on the plug-in RF boards.

3 MC/S I. F. AMPLIFIER

8. The first stage of the amplifier is fed from the second mixer-buffer amplifier via a band-pass crystal filter that determines the AM and CW response and augments the selectivity of the single-sideband filters.
9. The LSB, USB filter and AM-CW broadband coupling are situated between the first and second amplifier stages and are selected by switch wafers 2SA1 and 2SA3.
10. The third stage of the i.f. amplifier provides the output to the a.g.c. and detector stages.

AUTOMATIC GAIN CONTROL (A.G.C.)

11. The d.c. level for the a.g.c. is obtained by detecting part of the 3 Mc/s i.f. output and amplifying it. The amplified a.g.c. voltage is applied to the r.f. amplifier, 1st mixer and the first stage of the 3 Mc/s i.f. amplifier.

DETECTOR AND CARRIER RE-INSERTION OSCILLATOR

12. For both modes of S.S.B. reception, the 3 Mc/s i.f. amplifier output is fed to a detector with the 3 Mc/s output from the carrier re-insertion oscillator applied to it to function as a product detector. During A.M. and C.W. reception the carrier re-insertion oscillator is inoperative and the stage functions as a leaky base detector.

B.F.O.

13. The B.F.O. is operative only during C.W. reception. The output from the B.F.O. is injected into the detector input to produce a beat note, that is subsequently amplified by the a.f. amplifier. The B.F.O. control regulates the pitch of this beat note.

A.F. STAGES

14. The audio output from the detector is fed into a pre-amplifier via the AF GAIN control. The pre-amplifier acts as a low gain buffer stage between the detector and main amplifier and also defines the shape of the a.f. response for the main amplifier.
15. The main amplifier is suitable for direct coupling to a 15-ohm loudspeaker at a maximum output of 500 mW. The output is also available at a jack socket on the receiver's front panel for headphone use.

16. A nominal 10 mW, 600 ohm output is available via an isolating transformer for feeding external lines. A pre-set control in the a.f. amplifier enables this output to be adjusted to the desired level. The transformer output winding is centre-tapped and connected to three terminals on the rear panel of the receiver. This permits the output to be balanced to earth, unbalanced, or fully-floating, as required.

SQUELCH

17. The squelch is operated by the output level from the main a.f. amplifier. It mutes the receiver automatically when the output falls below a pre-determined level set by the SQUELCH control. The loudspeaker, headphones and external line transformer are thus only connected whilst acceptable signal levels are being received. After setting-up, variations in signal strength can be compensated by adjustment of the RF GAIN control.

CHAPTER 5

CIRCUIT DESCRIPTION

INTRODUCTION

1. For the purpose of this description reference should be made to the Simplified Overall Receiver Circuit (fig. 25) and the individual circuits for the sub-units.

R. F. UNIT (Fig. 4)

2. The r.f. unit comprises a r.f. amplifier, a buffer amplifier, a first mixer and eight r.f. plug-in boards which are selected by the CHANNEL switch. For frequency range purposes there are four range types, of which any permutation may be used and are aligned to desired frequencies within their respective ranges. For the sake of clarity on the circuits, plug-in boards are not depicted for all of the channels, i.e. for channels 1 and 2 range 1 and 4 boards are shown in figure 25, whilst in figure 4 ranges 2, 3, 4 and 1 are shown for channel positions 1, 2, 7 and 8 respectively.

R. F. Amplifier

3. The aerial input at 1SKT1 is fed via the aerial muting relay contact 1RLA1 to switch wafer 1SA1B on the CHANNEL switch, to select the desired channel band-pass filter. Switch wafer 1SA1F applies a short circuit across the remaining seven inputs. The band-pass filter output is selected by switch wafer 1SA2B for amplification by the grounded emitter amplifier 1VT1 whilst switch wafer 1SA2F performs a similar function to 1SA1F. Relay coil 1RLA/2 is energised by the closure of a suitable transmit contact incorporated at a transmitter, relay contact 1RLA1 leaves the aerial input open-circuited and applies an earth to the input of the selected 'r.f. board'. The second relay contact 1RLA2 applies the positive h.t. line to the a.g.c. line, thus the r.f. amplifier, mixer and 1st i.f. amplifier will be biased to cut-off. The receiver audio output will also be muted due to the action of the squelch unit (see paras. 60-64) on receivers with this facility.
4. A germanium diode 1MR1 is connected between the base and emitter of transistor 1VT1 is included for transistor protection against transients appearing at the aerial input.
5. The output appearing at the collector of transistor 1VT1 is selected by switch wafer 1SA3 to feed a second band-pass filter on the selected "r.f. board". Switch wafer 1SA4B selects the output from this filter to feed it to the first mixer (1VT3) input. The remaining channel filter outputs are short-circuited by switch wafer 1SA4F.

Buffer Amplifier

6. The buffer-amplifier (1VT2) functions as an emitter-follower and is included between the channel oscillator output and the first mixer to minimise the loading on the channel oscillator.

First Mixer

7. The silicon diode 1MR2 is included in the base circuit of the first mixer (1VT3) to provide the transient protection for this stage.
8. When the receiver is operating on frequencies below 7 Mc/s, the channel oscillator operates at a frequency of 700 kc/s above the signal frequency to provide a 700 kc/s output at the collector of the first mixer transistor.
9. An output of 3 Mc/s appears at the collector of the first mixer when the receiver is operating at frequencies above 7 Mc/s. The 3 Mc/s output being obtained from the mixer by the channel oscillator now functioning at 3 Mc/s from the signal frequency.
10. The 700 kc/s or 3 Mc/s mixer output is applied to the switching diodes 1MR3 and 1MR4. When these diodes are reverse biased by applying a positive voltage to their cathodes, any signal from the mixer will not be conducted through them. The diodes are switched into a conducting condition to a mixer signal by forward biasing their cathodes with a negative voltage. The reverse and forward biasing of the diodes involves a transistor stage and relay coils in the i.f. unit (see paragraphs 13 to 15).
11. Pin number 23 on all the "r.f. boards" is connected to the negative h.t. line. For "r.f. boards" tuned to frequencies between 1.5 and 7 Mc/s there is an electrical link between pins 22 and 23, and pins 23 and 24 are linked on "r.f. boards" for the ranges between 14 and 24 Mc/s. There is no link from pin 23 on "r.f. boards" covering the 7 to 14 Mc/s frequency range.
12. Switch wafer 1SA6 selects each of the pins numbered 22 on the eight r.f. board sockets (1SKT2 - 1SKT9), whilst wafer 1SA5 selects each of the pins numbered 24 from these sockets.
13. Figures 4 and 25 show the switch wafers 1SA5 and 1SA6 in the Channel 1 position and a "r.f. board" within the frequency range of 1.5 to 7 Mc/s, resulting in the following conditions:-
 - (a) A negative h.t. voltage is applied to the cathode of diode 1MR3 via pins 22 and 23 of socket 1 SKT2, switch 1 SA6, resistor 1 R13 and coils 1L4, 1L22, 1L21, to permit the signal flow of the 700 kc/s through the diode.
 - (b) The negative voltage appearing at the junction of resistor 1R13 and the wiper of switch 1SA6 is applied to the coil of relay 2RLA/2, the negative h.t. line of the 3.7 Mc/s oscillator, via 2MR5 to relay coils 2RLB/2, 2RLC/2 to the base of n.p.n. transistor 2VT10 through resistor 2R47. Relay 2RLA/2 operates to select a 700 kc/s tuned circuit in the i.f. unit input and the 3.7 Mc/s crystal oscillator will function (see figs. 8 and 25). Relays 2RLB/2, 2RLC/2 operate and as transistor 2 VT10 is a n.p.n. type, it will be biased to cut-off.
 - (c) Pin 24 on socket 1SKT2 is open circuited, preventing a negative voltage being applied to switch wafer 1SA5. The cathode of diode

1MR4 has a positive voltage applied to it via resistors 1R11, 1R12 and coil 1L5 to prevent a 700 kc/s signal flow through 1MR4.

14. Channel 2 in figure 4 shows a 7 to 14 Mc/s "r.f. board" selected with the following results:-
- (a) No link is provided between pin 23 to either pin 22 or 24, so that no negative h.t. can be selected by either switch wafer 1SA5 or 1SA6. Diode 1MR3 will be reverse biased by a positive voltage derived through relay coil 2RLA/2, resistor 1R13 and coils 1L4, 1L21, 1L22. Diode 1MR3 will accordingly not pass the mixer output signal.
 - (b) Neither the 3.7 Mc/s oscillator or the relay 2RLA/2 will be operating. Relay contact 2RLA2 will select the 3 Mc/s tuned circuit and contact 2RLA1 applies a short circuit to the 700 kc/s tuned circuit in the i.f. unit input.
 - (c) With no negative h.t. applied to relay coils 2RLB/2 and 2RLC/2 will be de-energised, but they will apply a positive voltage to the base of n.p.n. transistor 2VT10 via resistor 2R47. Transistor 2VT10 will be driven into conduction, to develop a negative going potential across resistor 1R12. This negative potential is fed through resistor 1R11 and coil 1L5 and will be sufficient to forward bias diode 1MR4 to permit the 3 Mc/s signal output from the mixer will pass through the diode.
15. Consider the switches 1SA5 and 1SA6 in figure 4 are in the Channel 7 position. The "r.f. board" shown for this position is within the range of 14 to 24 Mc/s and the following conditions will arise:-
- (a) Pin 22 on socket 1SKT8 is open circuited and no negative voltage will be applied to the cathode of 1MR3. This diode will now be reverse biased due to a positive voltage derived via relay coil 2RLA/2, resistor 1R13 and coils 1L4, 1L22, 1L21. Any signal flow from the 3 Mc/s mixer will accordingly be inhibited through 1MR3.
 - (b) The relay 2RLA/2 will be inoperative as any current through the coil will be insufficient to operate it. The relay contacts select the 3 Mc/s tuned circuit in the i.f. unit input and the 3.7 Mc/s oscillator will not be functioning.
 - (c) A negative d.c. path is provided to the cathode of diode 1MR4 via pins 23 and 24 of socket 1SKT8, switch 1SA5, diode 2MR7, resistor 1R11 and coil 1L5. The negative voltage is high enough to override the standing positive voltage at the junction of resistors 1R11 and 1R12. Diode 1MR4 will be in a forward biased condition, to permit the 3 Mc/s signal from the first mixer to flow. Relays 2RLB/2 and 2RLC/2 will operate due to the negative voltage from switch 1SA5 through diode 2MR6. The n.p.n. transistor 2VT10 will be cut-off

as a result of this negative voltage being present at its base.

16. The signal output from the diode 1MR3 is fed into two band-stop filters, that are connected in series. Coil 1L21 and capacitor 1C22 form a filter tuned to 3 Mc/s, and coil 1L22 and capacitor 1C21 combine to form a filter at 4.4 Mc/s. These filters are included to remove harmonics at these frequencies that may be present in the first mixer output and cause spurious signals in the i.f. amplifier.
17. Capacitor 1C14 and coil 1L4 form a tuned output circuit at 700 kc/s to feed the second mixer in the i.f. amplifier via capacitor 1C19.
18. Capacitor 1C15 and coil 1L5 are tuned to the 3 Mc/s output from the diode 1MR4, to form an output circuit via capacitor 1C20 to the buffer amplifier in the i.f. unit.

CHANNEL OSCILLATOR (Fig.6)

19. The channel oscillator consists of a mounting board with a crystal oven, trimming capacitors and pre-set potentiometers mounted on it. The crystal oven contains the oscillator circuit, the eight crystals and the transistorised oven temperature control circuit.

Oscillator

20. The output frequency from the oscillator will be 700 kc/s above the signal frequency when operating on channel frequencies below 7 Mc/s, and for signal frequency channels above 7 Mc/s, the oscillator frequency is 3 Mc/s from that of the signal frequency, i.e. 3 Mc/s above the signal frequency for the range 7 to 14 Mc/s and 3 Mc/s below the signal frequency for the range 14 to 24 Mc/s.
21. A two stage transistor amplifier with the output fed back to the input forms an untuned oscillator. A parallel resonant crystal is connected from the collector of one transistor to the collector of the other transistor to restrict the oscillation of the circuit to that of the selected crystal.
22. Channel switch wafers 3SA7B and 3SA8B select the desired crystal for the appropriate channel and wafers 3SA7F and 3SA8F apply a short circuit across the remaining seven crystals. Trimming capacitors 3C5 to 3C12 "pull" the respective crystals exactly on to the desired oscillator frequency.

Crystal Oven

23. The oven is heated by the heat dissipation from a power transistor that is fixed onto the oven body. A contact type thermistor provides the control over the power dissipation through an amplifier, and a thermal cut-out using a phosphor bronze strip and Woods Metal protects the oven against over heating.
24. A zener diode 3MR1 and resistor 3R8 provides a stabilized supply to a long-tail transistor pair 3VT3 and 3VT4 with a common emitter resistor 3R7. Thermistor 3TH1, resistor 3R2 and the pre-set potentiometer 3RV1 form a bridge circuit around the long-tail pair. The resistance of the ther-

mistor varies with a change in temperatures of the crystal oven, thus the voltage applied to the base of transistor 3VT3 will change in relationship with the thermistor resistance so that the conduction state of the transistor will be controlled. The second transistor 3VT4 in the long-tail pair will also be affected, except that the potentiometer 3RV1 will determine the "cut-off" point for this transistor. This potentiometer will accordingly provide control over the operating temperature of the oven.

25. The output from the collector of transistor 3VT4 is taken to a n.p.n. transistor amplifier 3VT5. The current gain of this transistor is controlled by a pre-set variable resistor 3RV2 and determines the base current to transistor 3VT6.

26. Transistor 3VT6 is the crystal oven heating element with the collector supplied from a negative unstabilized supply via the oven temperature safety trip. The emitter contains a low value resistor 3R16 for stabilization against thermal runaway and a diode 3MR2 to improve the cut-off characteristics of the transistor.

I. F. UNIT (Fig. 8)

27. The i.f. unit contains a 3.7 Mc/s crystal oscillator, a second mixer or buffer amplifier, i.f. amplifier at 3 Mc/s with L.S.B. and U.S.B. filters and an a.g.c. detector with an amplifier.

28. The 700 kc/s and 3 Mc/s inputs from the r.f. unit are fed into coils 2L1 and 2L2 respectively. When a 700 kc/s signal is available from the first mixer, relay 2RLA/2 is energised so that contact 2RLA2 will select the output from 2L1 to the base of transistor 2VT2 and contact 2RLA1 will apply a short-circuit across the secondary winding of 2L2. Should the first mixer output be at 3 Mc/s, the relay 2RLA/2 will be in a de-energised condition and contact 2RLA2 will apply the output from coil 2L2 to the base of 2VT2 whilst contact 2RLA1 will short-circuit the secondary winding of 2L1.

3.7 Mc/s Oscillator

29. Transistors 2VT1 and 2VT3 form an oscillator that is basically similar to the channel oscillator but with only a 3.7 Mc/s crystal. The resistor-capacitor networks 2R18, 2C9 and 2R17, 2C11 provide decoupling of the h.t. lines.

39. As already described in paragraph 13 of this chapter, this oscillator is only functioning when the first mixer output frequency is at 700 kc/s. The 3.7 Mc/s oscillator output is fed via capacitor 2C42 to the junction formed by the 2L1 coupling winding and relay contact 2RLA2.

Second Mixer-Buffer Amplifier

31. Transistor 2VT2 functions as a fixed low gain mixer producing a 3 Mc/s output at the collector when a signal input at 700 kc/s and the 3.7 Mc/s from the oscillator are applied to its base.

32. Transistor 2VT2 functions as a low-gain buffer amplifier at 3 Mc/s when

a 3 Mc/s signal from the first mixer in the r.f. unit is applied to its base.

I. F. Amplifier

33. This is a three stage amplifier with a System switch incorporated so that the receiver may be operated under L.S.B., U.S.B., A.M., C.W. or TUNE conditions.
34. The 3 Mc/s output from transistor 2VT2 collector is fed via capacitor 2C12 to a crystal L-C filter to determine the a.m. and c.w. response and the selectivity of the single sideband filters. The crystal L-C filter consists of three tuned circuits 2L12, 2C43; 2L13, 2C45, 2R43 and 2L14, 2C46 with crystals 2XL2 and 2XL3 inserted between the first and second tuned circuits and inserted between the second and third circuits are crystals 2XL4 and 2XL5. Coils 2L12 and 2L14 are centre tapped to earth to provide a balanced input and output respectively for the filter. Trimming capacitor 2C44 is the phasing control for the bandwidth, whilst the tuned circuit formed by 2L13, 2C45 and 2R43 is included to give a level response within the bandwidth. The output from the filter is taken from a coupling winding on 2L14 to prevent loading of the filter circuit by the base of the following transistor stage 2VT4.
35. Transistors 2VT4 and 2VT5 function as common-emitter amplifiers in the first and second stages of the i.f. amplifier. The coupling between the two stages is by means of crystal L-C filters for the S.S.B. positions of the System switch and via a broad-band transformer coupling for the A.M., C.W. and TUNE positions. The L.S.B. and U.S.B. filters provide rejection of the carrier for either the upper or lower sidebands respectively. Wafers 2SA3F and 2SA1Fa on the System switch select the appropriate interstage coupling, whilst wafers 2SA4F and 2SA2F short circuit the inputs and outputs of the two remaining coupling circuits.
36. Relays 2RLB/2 and 2RLC/2 operate when "r.f. boards" in the frequency ranges 1.5 to 7 Mc/s and 14 to 24 Mc/s are selected. When a 7 to 14 Mc/s frequency range "r.f. board" is selected, these two relays are de-energised. Paragraphs 13(b), 14(c) and 15(c) describe how energising and de-energising of the relays is obtained. When the channel oscillator is operating at 3 Mc/s above the signal frequency, as for 7 to 14 Mc/s r.f. boards, the sideband sense is in reverse with respect to that for when the channel oscillator is 3 Mc/s below the signal frequency. Relay contacts 2RLB1 and 2RLB2 reverse the inputs to the L.S.B. and U.S.B. filters and contacts 2RLC1, 2RLC2 reverse the L.S.B. and U.S.B. filter outputs when relays 2RLB/2 and 2RLC/2 are in a de-energised condition i.e. the L.S.B. filter becomes the U.S.B. filter and the original U.S.B. filter is used for L.S.B.
37. The coupling between the second and third stages of the i.f. amplifier is via a 3 Mc/s tuned circuit formed by capacitor 2C25 and coil 2L9 in the collector of transistor 2VT5.
38. The third amplifier stage 2VT6 is a common-base amplifier, to obtain a large collector voltage swing consistent with good linearity. The output appearing on the collector of 2VT6 is taken to the a.g.c. circuit via coil 2L10

and to the signal detector in the a. f. amplifier via coupling capacitor 2C37. This coupling capacitor has a low value of capacitance to achieve good isolation by means of attenuation between the a. g. c. detector and the 3 Mc/s carrier re-insertion signal.

39. The System switch wafer 2SA1Fb applies the positive h. t. line to the 3 Mc/s carrier re-insertion oscillator and to relay coil 4RLA/2 in the a. f. unit when in the L. S. B. , U. S. B. and TUNE positions of the switch. In the C. W. position, the positive h. t. is applied to the B. F. O.

A. G. C. Detector and Amplifier

40. The 3 Mc/s signal from the secondary winding of coil 2L10 feeds a peak detector circuit comprising a diode 2MR1, capacitor 2C32 and diode load resistor 2R33. The potentiometer 2RV1 and diode 2MR2 between the a. g. c. detector and amplifier provides an independent pre-set a. g. c. knee voltage to control the delay constant.

41. The output from 2MR2 is fed to a two stage direct coupled amplifier 2VT9 and 2VT8 to produce the amplified a. g. c. output. A pre-set potentiometer 2RV2 permits the adjustment of the quiescent a. g. c. voltage and hence the overall receiver gain. The amplifier has a high input impedance to minimise the loading of the last i. f. stage and a low output impedance to maintain the attack time constant. A third transistor 2VT7 is included in the amplifier for temperature compensation purposes, to prevent variations in gain in the amplifier that may otherwise occur with temperature changes.

42. Choke 2L11, resistor 2R38 and capacitors 2C34, 2C35 are included to provide adequate decoupling of the a. f. signals due to the low impedance of the a. g. c. line. The diodes 2MR3 and 2MR4 shunt 2L11 and 2R38 during a period increasing signal. The charge time constant involves the dynamic resistance of transistor 2VT8, diodes 2MR3, 2MR4 and capacitors 2C34, 2C35. The discharge time constant includes capacitors 2C34, 2C35, and a. g. c. load impedance of choke 2L11 in series with the emitter resistor 2R36.

43. Resistor 2R44 and the R. F. GAIN potentiometer 2RV3 form a potential divider between the negative and positive h. t. lines. Variation of this potentiometer will affect the voltage present on the a. g. c. line to independently control the r. f. gain of the receiver. The a. g. c. line applies control to the r. f. amplifier, mixer and first i. f. amplifier stages.

3 MC/S CARRIER RE-INSERTION OSCILLATOR (Fig. 10)

NOTE: See paras. 90 and 91 for description of pre-set version.

44. The positive h. t. line to this sub-unit is selected by System switch wafer 2SA1Fb in the i. f. unit, to permit oscillation in the L. S. B. , U. S. B. and TUNE positions only. The oscillator functions as a crystal controlled Clapp type oscillator. By restricting the drive to the signal detector to four or five times the signal level, the inclusion of capacitor-resistor networks 5C8, R5R, 5C6, 5R6 and 5C7, 5R3 in the supply lines and screening of the module, reduction of possible feed-back to the r. f. amplifier is achieved.

45. The 3Mc/s crystal frequency can be pulled (150 c/s) by a silicon variable capacitance diode 5D1, which is connected series with the crystal 5XL1 and capacitor 5C3. The capacitance of 5D1 is determined by the potential applied to it. The CLARIFIER potentiometer 5RV1 resolves this potential via resistors 5R2 and 5R3. The capacitor 5C4 and coil 5L1 form a tuned collector load at 3 Mc/s to provide the output to the signal detector in the a.f. unit via capacitor 5C5 and relay contact 4RLA1.

BEAT FREQUENCY OSCILLATOR (B.F.O.) (Fig. 12)

46. This oscillator is only operational when the System switch wafer 2SAIFb (in the i.f. unit) is in the C. W. position, and switches the positive h. t. supply onto this unit.

47. The B.F.O. is a single transistor (8VT1)L-C oscillator with an output taken from the collector to the signal detector via resistor 8R8 and capacitor 4C32. The control of the output frequency is continuously variable by means of the B.F.O. control 8RV1, which applies a voltage to a variable capacitance diode 8MR1. Variation of the potentiometer 8RV1 will change the voltage applied to the diode 8MR1, to result in a change of its capacitance and accordingly the output frequency from the oscillator.

AUDIO AMPLIFIER UNIT (Fig. 14)

48. The audio amplifier comprises the signal detector, pre-amplifier and main amplifier with outputs to the loudspeaker, headphone jack socket and the external line transformer.

Signal Detector

49. The n.p.n. transistor 4VT1 is used as the detector to obtain some gain from the stage. Product detection is used for S.S.B. and bottom bend transistor detection for a.m. The change-over being achieved by relay contacts 4RLA1 and 4RLA2 that alter the biasing conditions of the detector. The A.F. GAIN control 4RV3 in the collector circuit feeds the pre-amplifier stage (4VT2) via 4C10.

50. Relay coil 4RLA/2 is in the energised condition when the System switch wafer 2SAIFb is in the L.S.B., U.S.B. and TUNE positions, to remove the short-circuit across resistors 4R4, 4R5 by contact 4RLA1 and across 4R8 by contact 4RLA2. Contact 4RLA1 will now apply the carrier re-insertion signal to the base of the detector via an isolating resistor 4R3 so that 4VT1 is operating in the product detector mode.

51. In the A.M. and C.W. positions of the System switch the relay 4RLA/2 will not be energised and contact 4RLA1 will short-circuit resistors 4R4 and 4R5 whilst contact 4RLA2 short-circuits 4R8. In the C.W. position of the System switch, the output from the B.F.O. will be applied to the detector base via 4C32.

Pre-Amplifier

52. Transistor 4VT2 forms the pre-amplifier that serves as a low gain buffer

between the detector and the main amplifier. The pre-amplifier also defines the shape of the a.f. response, with capacitors 4C9 and 4C13 as the l.f. and h.f. shaping components respectively.

Main Amplifier

53. The main amplifier is a directly-coupled four-stage feedback amplifier that is suitable for direct matching into a loudspeaker with a 15 ohm speech coil. The output transistors operate in class AB push-pull to deliver 500 milliwatts at under 5% distortion to the loudspeaker.
54. The output from the pre-amplifier is fed via capacitor 4C14 and resistor 4R15 to the base of the main amplifier input transistor 4VT3. This transistor operates with a small collector current to ensure a low noise factor and as an emitter-follower stage, feeding the base of grounded-emitter voltage amplifier 4VT4. The collector output from transistor 4VT4 feeds the two-stage push-pull output circuit.
55. The two-stage push-pull circuit hinges round the use of complementary symmetry i.e. an n.p.n. -p.n.p. pair of transistors. Transistor 4VT7 is an n.p.n. transistor that acts as an emitter follower for the positive half cycles of the input with transistor 4VT5 cut-off. Similarly, transistor 4VT5 conducts for the negative half cycles of the input and 4VT7 is now cut-off. Transistor 4VT6 and 4VT8 follow their respective transistors 4VT5 and 4VT7.
56. Pre-set control 4RV1 provides the balance adjustment for complementary symmetrical operation. Control 4RV2 with diodes 4MR1 and 4MR2 in series, determines the quiescent current in the output transistors. The diodes are biased in the conducting direction on a portion of their characteristic giving a high degree of voltage stabilization across them to compensate for temperature variation. Resistors 4R27 and 4R28 are included in the emitters of 4VT6 and 4VT8 respectively to give a good thermal stability under adverse conditions. Capacitor 4C27 and resistor 4R24 provide an overall negative feedback loop from the output to the amplifier input.
57. The amplifier output is taken to the loudspeaker (4LS1), the headphone jack (4JK1) and the external line transformer 4T1 via relay contact 7RLA1 in the squelch unit, or if this unit is not incorporated, via a wire link (4LK1).
58. The output to the external lines via transformer 4T1 can be suitably attenuated by control 4RV4.
59. One side of the loudspeaker and the external line transformer 4T1 are taken to the junction of capacitors 4C28 and 4C29 which are connected in series between the h.t. lines. This arrangement avoids the capacitor charging current flowing through the output transistors, the loud speaker and transformer 4T1 when the receiver is switched on. These capacitors provide extra h.t. smoothing whilst they are effectively in parallel at audio frequencies.

SQUELCH UNIT (Fig. 14)

60. The squelch unit derives its signal input from the main amplifier output.

A relay coil 7RLA/1 in the collector of the final transistor is energised when a pre-determined audio level is obtained. The SQUELCH control 7RV1 determines this level. With the relay in the energised condition, the associated relay contact 7RLA1 applies the main amplifier output to the loudspeaker (4LS1), the headphone jack (4JK1) and the external line output transformer (4T1). In the de-energised condition, the relay contact isolates the loudspeaker etc. and applies resistor 7R1 as a 15 ohm load to the amplifier output.

61. The resistor potential divider 7R2, 7R3 has a resistance ratio, such that the 7R2, 7R3 junction potential is close to that of the positive supply line. This potential is applied to the base of transistor 7VT1 via resistor 7R4 so that 7VT1 will be in a none conducting state for low amplitude signals or no signal conditions at the base of transistor 7VT1. When a signal with a sufficiently high amplitude is applied to 7VT1 base the negative peaks of the signal will develop a negative potential across resistor 7R4 to drive the transistor into conduction.

62. Transistors 7VT1 and 7VT2 are directly coupled, hence when transistor 7VT1 is not conducting, the base of 7VT2 assumes the potential determined by the potential divider network 7R5, 7R5a, and 7R6, 7R6a, and is sufficiently negative for transistor 7VT2 to be in a conducting state. In this state, the 7VT2 collector current through resistor 7R7 reduces the negative potential at the base of transistor 7VT3 and the 7VT2 emitter current through resistor 7R10 increases the voltage applied to the 7VT3 emitter, so that transistor 7VT3 will not conduct and relay 7RLA/1 is in the de-energised condition.

63. Consider transistor 7VT1 in the conducting state, the 7VT1 collector current will reduce the negative base potential to a level that will prevent transistor 7VT2 from conducting and the voltage drop across resistor 7R7 will be negligible. Consequently the base of transistor 7VT3 will be sufficiently negative for 7VT3 to conduct and energise relay 7RLA/1.

64. The high capacitance of 7C3, removes the fluctuating d.c. level at the base of 7VT2 when transistor 7VT1 is conducting. When transistor 7VT3 is not conducting, capacitor 7C4 prevents conduction occurring due to transient input pulses. The diode 7MR1 in the collector of 7VT3, provides transistor protection against back e.m.f. that may be produced by relay coil 7RLA/1.

POWER UNITS

A. C. Powered Supply Unit (Fig. 16)

65. The a.c. power supply is filtered by capacitors 6C7 and 6C8 and taken to the voltage selector panel. The voltage selector panel connects the supply to the appropriate tapping points on the primary windings of transformer 6T1.

66. The secondary winding of 6T1 feeds a bridge connected full-wave rectifier 6MR4, 6MR5, 6MR6 and 6MR7. Capacitors 6C5, 6C6 and resistor 6R7 are included across the secondary winding of the transformer as protection against mains-borne transients.
67. The bridge rectifier feeds the negative line of the 24 volt unregulated output and a diode-capacitor filter and thence a series voltage regulator. The purpose of the diode (6MR3) is to isolate the negative line of the unregulated output from the smoothing capacitors 6C4b and 6C4c.
68. The series voltage regulator is of conventional design with a two stage control amplifier employing transistors 6VT2, 6VT3 and a 7 volt reference level from a zener diode 6MR9. The inclusion of the forward diodes 6MR1 and 6MR2 in series with the zener diode is to provide temperature compensation. The pre-set potentiometer 6RV1 is used to set the regulated supply to 20 volts. The output from the control transistors 6VT2 and 6VT3 is applied to the base of the series transistor 6VT1. Capacitor C4a is included across the regulated supply output to reduce the ripple voltage.
69. The +12 volt stabilized supply (relative to the negative regulated line) is derived from a 12 volt zener diode 6MR8. This zener diode is partially temperature compensated by diode 6MR10.

24 Volt D. C. Powered Supply Unit (Fig. 18)

70. The 24 volt unit comprises an input supply filter and series regulator circuit. The filter (10C1, 10C2, 10C3, 10C4 and 10L1) suppresses supply transients in excess of 25 volts above nominal. The filter incorporates change-over links to accommodate either positive or negative earthed supplies. The polarity of the receiver chassis is determined by change-over links.
71. The filter output is taken to the unregulated output and the diode capacity filter. The purpose of the diode 12MR6 is to provide reverse polarity protection and also isolate unregulated supply load from the smoothing capacitors C5 and C6. The output is fed to the series voltage regulator.
72. The series voltage regulator and +12 volt stabilizer circuits function identically to the circuit described for the A. C. Powered Supply Unit (see paras. 68-69).

12 Volt D. C. Powered Supply Unit (Fig. 20)

73. 12 volt d.c. unit incorporates a d.c. - a.c. inverter and a series voltage regulator. Capacitor 11C1 across the power input to the inverter suppresses transients in the power supply input. The positive or negative supply inputs may be earthed by means of a link to suit the supply.
74. The inverter is of conventional design utilizing transistors 11VT1 and 11VT2 in push-pull and a saturable core transformer 11T1. The secondary winding of the transformer feeds a bridge connected full-wave rectifier 13MR7, 13MR8, 13MR9 and 13MR10. The output from this bridge rectifier is fed to the negative line of an unregulated supply, a diode capacitor filter

and series voltage regulator which are functionally identical to the A. C. Powered Supply Unit (see paras. 67-69).

EXTENDED CONTROL RECEIVER MODULE MA. 346 (Fig. 22)

Introduction

75. This module is fitted by the manufacturer into receivers to provide extended control facilities. Reference should be made to the Circuit Diagram (Fig. 22) for the purpose of this description, which also incorporates part of the Extended Control Unit LA. 370 to complete the control systems employed.
76. The channel selection section of the MA. 346 employs a d. c. motor and electro-magnetic clutch system to drive switch wafers. A chain and sprocket drive mechanically couples the receiver CHANNEL switch shaft to the MA. 346 wafer switch shaft via a gear wheel shaft clamp. The motor driven switch wafers (9SA1B, 9SA2B) in the MA. 346 are interconnected by five lines in a multi-core cable to similar switch wafers at the LA. 370 to form a d. c. loop between the two sets of switches. When this d. c. loop is broken by the action of changing to a different channel on the LA. 370, the motor driven wafers switches in the MA. 346 will rotate until contacts are found to complete the d. c. loop.
77. The extended control of the RF. GAIN, CLARIFIER and BFO for the receiver is effected by relay coils in the MA. 346 being energised when the REMOTE position is selected on the receiver LOCAL-REMOTE switch. The relay contacts providing change over from the controls in the receiver to those at the extended control point on the LA. 370.

Unit Inter connections

78. Provision is made in the cable forms for the receiver to incorporate the MA. 346 into the receiver. Figure 21 provides details of these connections.
79. A twelve line multi-core cable is required for connecting the Extended control Unit LA. 370 to the MA. 346 in the receiver. The twelve core connector is terminated by a plug at the receiver end and by a socket at the LA. 370 end.
80. Nine of the lines in the connector are used for extended control of the receiver. Five of these nine lines are for channel selection and three providing RF gain, BFO and Clarifier control with the ninth line being used as a common positive line.
81. When a 20 volt supply for the amplifier in the LA. 370 is derived from the receiver, the common line is also used as one (positive) of the two supply lines.
82. The two remaining lines in the connector carry the a. f. signal from the external line transformer in the receiver to the LA. 370 amplifier.

Channel Selection

83. Switch wafer 9SA1F, 9SA1B and 9SA2B have nine positions, eight are for channel selection and one for the STANDBY position. Wafer 9SA1F applies the negative regulated supply to the receiver modules for all the positions of the switch except the STANDBY position.
84. When the motor driven switch wafers 9SA1B and 9SA2B and switch wafers SA1 and SA2 in the LA. 370 are both in their correct positions for a selected channel e.g. Channel 1, the negative supply present on the wiper contact of 9SA1B is applied via the connector to wafer SA1 in the LA. 370. The wiper contact of SA1 applies this negative supply to the wiper of SA2, the CLARIFIER control, the B.F.O. control via R1, the R.F. GAIN control via R2 and ILP1 to light the indicator bulb. Switch wafer SA2 in the LA. 370 applies the negative supply to wafer 9SA2B via the inter-unit connector and the wiper of 9SA2B applies this negative supply in turn to the base of transistor 9VT1 via resistor 9R2. This negative supply will cause the transistor to conduct and energize relay coil 9RLA/2. With the relay in the energized condition, relay contact 9RLA1 breaks the negative unregulated supply to the motor and the electro-magnetic clutch to prevent any rotation of the MA. 346 switch wafer shaft. The relay contact 9RLA1 will now apply the negative unregulated supply to the Crystal Oven.
85. The action of selecting a new position on the CHANNEL switch for the LA. 370 will result in switch wafers SA1 and SA2 breaking negative supply to the indicator lamp and the base of transistor 9VT1. Under these conditions, the transistor will not conduct and relay 9RLA/2 will de-energize. With relay now in the de-energized condition, relay contact 9RLA1 will break the negative unregulated supply to the crystal oven and apply this supply to the motor and electro-magnetic clutch so that switch wafers 9SA1B and 9SA2B are rotated until contacts are found that will cause transistor 9VT1 to conduct and energize relay 9RLA/2.
86. Rectifier 9MR1 is included in the motor (9X1) supply line to prevent any voltage generated by the continued rotation of the rotor after the motor has been switched off from actuating the electro-magnetic clutch coil (9X2). Rectifier 9MR2 is inserted in parallel with the electro-magnetic clutch coil to suppress the back e.m.f. produced when the clutch coil is de-energized. Rectifier 9MR3 across relay coil 9RLA/2 is also for back e.m.f. suppression.

Receiver - Extended Control Change Over

87. The LOCAL-REMOTE switch (9SBa, 9SBb) on the receiver front panel provides the change over of control from the receiver to the Extended Control Unit LA. 370. In the LOCAL position, switch section 9SBa applies the unregulated negative supply to the crystal oven. When

LOCAL-REMOTE switch is in the REMOTE position, the supply lines are completed for the electro-magnetic clutch, the motor, relay coil 9RLB/2 and the positive return for the emitter and base of transistor 9VT1.

88. In the de-energized condition for relay 9RLA/2, contact 9RLA2 provides control from the CLARIFIER control (5RV1) in the receiver. When relay 9RLA/2 is energized by the action of a channel having been selected, contact 9RLA2 transfers the control to the CLARIFIER potentiometer RV1 in the LA. 370. Relay 9RLA/2 cannot be energized if the LOCAL-REMOTE switch is in the LOCAL position irrespective of the rotary switch wafers positions in the MA. 346 and the LA. 370.

89. In the de-energized condition of relay RLB/2, contact 9RLB1 applies the B.F.O. potentiometer 8RV1 in the receiver to the B.F.O. module and contact 9RLB2 applies the receiver R.F. GAIN control 2RV3. For the energized condition of relay 9RLB/2, contact 9RLB1 transfers the B.F.O. control to RV2 in the LA. 370, and contact 9RLB2 to the R.F. GAIN potentiometer RV3 in the LA. 370.

PRESET 3 MC/S CARRIER RE-INSERTION OSCILLATOR (Fig. 27)

90. The positive h.t. line to this sub-unit is switched by wafer 2SA1Fb in the i.f. unit, to permit oscillation in the S.S.B. and TUNE positions only.

91. Transistors 5VT1 and 5VT2 form the re-insertion oscillator that is basically similar to the channel and 3.7 Mc/s oscillators, only differing in crystal frequency and the padding capacitors 5C9 and 5C10 in the trimmer circuit. The output is taken from the collector of transistor 5VT2 to the signal detector in the a.f. unit via capacitor 5C3 and relay contact 4RLA1. By restricting the drive to the signal detector to four or five times the signal level and screening of the module, reduction of possible feed-back to the r.f. amplifier is achieved. The resistor-capacitor networks R11, C6 and R12, C7 provide decoupling of the h.t. lines. The sub-unit is unsuitable for extended control operation.

CHAPTER 1

TEST EQUIPMENT

1. The following test equipment and components are required for the maintenance and fault location:-
 - (a) An Avo Model 8 or similar 20 000 ohms per volt multi-range instrument.
 - (b) Signal Generator (Airmec 201).
 - (c) Digital Frequency Counter (Racal SA.505 and 40 Mc/s Divider SA.512).
 - (d) Audio Generator (Advance H1).
 - (e) Output Meter (Marconi TF893A).
 - (f) Oscilloscope (Tecktronix 545A).
 - (g) Valve Voltmeter (Marconi TF1041).
 - (h) Valve Milli-voltmeter (Advance Advac).
 - (j) Capacitors as follows:-
 - 25 μ F electrolytic 12V Wkg. 2 off
 - 0.1 μ F paper 1 off
 - (k) Woods Metal (for repairing the Crystal Oven Temperature Safety Trip).

CHAPTER 2

DISMANTLING AND RE-ASSEMBLY

INTRODUCTION

1. The dismantling of the various sub-units of the receiver is described in this chapter and the re-assembly will be the reverse procedure unless otherwise stated.

REMOVAL OF CASE (Bench Models)

2. (1) Release the twist-screws on the top half of the case and lift off.
(2) The receiver sits in the lower half of the case and is removed by lifting the receiver off the locating pins fitted to this portion of the case.

REMOVAL OF FRONT PANEL

3. (1) Remove the five control knobs using a suitable allen key, noting the positions of the CHANNEL, CLARIFIER and System knobs for the re-assembly.
(2) Unscrew the five 2BA countersunk screws from the front panel and remove panel from the unit.

CHANNEL OSCILLATOR AND CRYSTAL OVEN

Removal from Main Chassis

4. (1) Disconnect the leads to the switch wafers and supplies. Note the lead colours and positions for re-connection.
(2) Remove the oven lid clamp held by two 2BA screws (if fitted).
(3) Remove the two 2BA screws and two pillars that secure the base plate to the mounting pillars.

Dismantling the Crystal Oven

5. (1) Remove the crystal oven cover and remove the crystals.
(2) To gain access to the crystal oscillator, remove the two 8BA screws from the top plate of the oven.
(3) The oven body is removed from the base plate by first removing the cover disc from the centre of the base plate. Disconnect the four leads between the oven and potentiometers 3RV1, 3RV2 and also the sixteen fine wires between the crystal holder tags and spills. Before removing the four 4BA nylon screws from the base plate, note the orientation of the oven on the base plate.
(4) Access to the heat dissipation compartment is now gained by removing the two screws in the tag board at the bottom of the oven.

REMOVAL OF I. F. UNIT

6. (1) Remove the front panel as described in paragraph 3.
- (2) Disconnect from the front of the i. f. unit, the co-axial cable and the two P. V. C. covered leads to the tag board above the speaker.
- (3) Disconnect from the rear of the i. f. unit, all leads to the top tag board on the rear strut.
- (4) If the Squelch unit is fitted remove the four fixing screws from the mounting pillars for this unit.
- (5) Remove the four 2BA screws securing the i. f. unit to the dummy front panel.
- (6) Remove the two 4BA screws that fix the rear of the i. f. unit to the rear cross member.

NOTE: If the unit is removed to gain access to components for Fault Finding, Re-Alignment etc. it is unnecessary to disconnect the leads as described in operations (2) and (3) above.

REMOVAL OF POWER SUPPLY UNIT

7. (1) Disconnect the leads from the cable form to the four stand off insulators on the component board, note the lead colours and respective positions for re-connection.
- (2) Note the power supply lead colours and positions and disconnect these leads from the power unit.
- (3) On the mains powered unit remove the support bracket by removing the two 4BA screws adjacent to the voltage selector and the two 4BA screws securing the bracket to the side member.
- (4) Remove the five 4BA screws securing the power unit mounting plate to the cross member.

EXTENDED CONTROL MODULE MA. 346

Removal

8. (1) Disengage the drive shaft from the MA. 346, i. e. the shaft coupled to the CHANNEL switch spindle by a chain and sprockets, by loosening the shaft clamp (see fig. 21) with a suitable allen key.
- (2) Remove the 15 pole socket from the rear panel of the receiver. Disconnect all leads between the MA. 346 and the receiver, noting the lead colours and their respective positions for re-connection.
- (3) Remove the Crystal Oven clamp (fitted on some models) and the two fixing screws at the side of the MA. 346, taking care not to damage or displace the trimmers on the Channel Oscillator mounting board.
- (4) Remove the four screws holding the rear member to the receiver.

With the receiver in this partially dismantled state care must be exercised to prevent strain to any leads still connected between the rear member and the receiver.

- (5) Remove the four screws and spacers securing the MA. 346 to the rear member.
- (6) Slide the unit backwards (away from the front panel) to free it from the drive shaft and lift the MA. 346 out of the receiver.

Re-Assembly

9. (1) Lower the MA. 346 into the receiver and slide the shaft clamp onto the drive shaft, taking care not to trap any loose leads between the unit and the chassis. Do not tighten the shaft clamp.
- (2) Fix the unit to the rear member using the four screws and spacers removed in operation 8(5). Do not fully tighten the screws.
- (3) Fit the rear member to the receiver and the two side fix screws to the MA. 346 removed in operation 8(3). Leave the screws loose.
- (4) Fit the 15 pole socket to the rear panel and re-connect all leads removed in operation 8(2).
- (5) Tighten all screws left loose in operations (2) and (3) and fit Crystal Oven clamp (if used).
- (6) Rotate the MA. 346 switch spindle by turning the large gear wheel until the switch wiper can be seen to be centrally located on a switch contact. Tighten the shaft clamp with a suitable allen key, taking care not to move the switch wiper from its located position.
- (7) Connect the receiver via a suitable cable to an LA. 370 Extended Control Unit and select the REMOTE position on the receiver LOCAL-REMOTE switch. Set the receiver POWER switch to ON.
- (8) When the MA. 346 has completed its channel selection sequence, set the POWER switch to OFF.

WARNING: TO PREVENT ANY RISK OF PERSONAL INJURY, THE POWER SWITCH MUST BE OFF WHEN MAKING ADJUSTMENTS TO THE MA. 346.

- (9) Carefully loosen the shaft clamp without disturbing the location of the switch wipers on the MA. 346 switch wafers.

NOTE: It is recommended that the large gear wheel on the MA. 346 is firmly held during this operation and operation (10).

- (10) Holding the large gear wheel on the MA. 346, set the CHANNEL switch on the receiver to the same position as already selected on the LA. 370 CHANNEL switch and then tighten the shaft clamp on the MA. 346.

- (11) Set the POWER switch to ON. Select each position in turn on the LA. 370 CHANNEL switch and check that the receiver CHANNEL switch selection is correct. If channel selection is unsatisfactory, switch the receiver POWER to OFF, loosen the shaft clamp and repeat operations (8) to (11) until satisfactory channel selection is obtained.
- (12) With the receiver POWER switch set to ON, check that reception is possible at the LA. 370 on all usable channels and also that R. F. GAIN, B. F. O. and CLARIFIER controls on the LA. 370 provide satisfactory operation.

R. F. UNIT

Removal

10. (1) Remove Crystal Oscillator and Oven as described in paragraph 4.
- (2) Remove the front panel as detailed in paragraph 3.
- (3) Disconnect aerial co-axial cable from relay 1RLA/2 and remove the side member adjoining the r.f. unit.
- (4) Disconnect all external leads noting their colours and relative positions for re-connection.
- (5) Remove the two 4BA fixing screws from cross member and the four screws holding the mounting pillars to the dummy front panel.
- (6) If the receiver is fitted with an Extended Control Module MA. 346, the dummy panel will have to be removed so that the chain can be disengaged from the sprocket on the Channel switch spindle.

Re-Assembly

11. (1) Lower the R. F. Unit into the receiver and fit the fixing screws removed in operation 10(5). Leave the four screws holding the mounting pillars to the dummy front panel until operation (7) if the receiver is fitted with an Extended Control Module MA. 346.
- (2) Re-connect all the leads removed in operation 10(4) and co-axial cable disconnected in operation 10(3).
- (3) Refix the Crystal Oscillator Oven and side member removed in operations 10(1) and 10(3) respectively.
- (4) Fit the front panel and control knobs; if the receiver is fitted with an Extended Control Module MA. 346, leave this operation until operation (7).
- (5) For receivers fitted with the Extended Control Module MA. 346, proceed as described in operations (6) to (14).
- (6) Re-engage the chain onto the sprocket on the Channel switch spindle and apply suitable tensioning to provide free chain movement with-

out slack.

- (7) Fit the dummy front panel and the screws left from operation (1). Fit the front panel and control knobs left from operation (4).
- (8) Loosen the shaft clamp on the MA. 346. Rotate the MA. 346 switch spindle by turning the large gear wheel until the switch wiper contact can be seen to be centrally located on a switch contact. Tighten the shaft clamp with a suitable allen key without any further movement of the switch spindle.
- (9) Connect the receiver via a suitable cable to an LA. 370 Extended Control Unit and select the REMOTE position on the receiver LOCAL-REMOTE switch. Set the receiver POWER switch to ON.
- (10) When the MA. 346 has completed its channel selection sequence, set the POWER switch to OFF.

WARNING: TO PREVENT ANY RISK OF PERSONAL INJURY, THE POWER SWITCH MUST BE OFF WHEN MAKING ADJUSTMENTS TO THE MA. 346.

- (11) Carefully loosen the shaft clamp without disturbing the location of the switch wipers on the MA. 346 switch wafers.

NOTE: It is recommended that the large gear wheel on the MA. 346 is firmly held during this operation and operation (12).

- (12) Holding the large gear wheel on the MA. 346, set the CHANNEL switch on the receiver to the same position as already selected on the LA. 370 CHANNEL switch and then tighten the shaft clamp on the MA. 346.
- (13) Set the POWER switch to ON. Select each position in turn on the LA. 370 CHANNEL switch and check that the receiver CHANNEL switch selection is correct. If channel selection is unsatisfactory, switch the receiver POWER to OFF, loosen the shaft clamp and repeat operations (10) to (13) until satisfactory channel selection is obtained.
- (14) With the receiver POWER switch set to ON, check that reception is possible at the LA. 370 on all usable channels and also that R. F. GAIN, B. F. O. and CLARIFIER controls on the LA. 370 provide satisfactory operation.

REMOVAL OF FILTER COUPLING BOARD

12. (1) Remove the leads to the main r.f. unit and to the tag board at the rear of the i.f. unit noting their positions for re-connection.
- (2) Remove the four 8BA screws and nuts from the two mounting angle brackets.

REMOVAL OF 3.7 Mc/s CRYSTAL OSCILLATOR

Removal of Oscillator Unit

13. (1) Remove the i.f. unit as described in paragraph 6 except that leads need not be removed in this procedure.
- (2) Remove the screening can at the rear end of the i.f. unit.
- (3) Temporarily fix the i.f. unit to the main chassis with two 2BA screws through the top two fixing holes in the dummy front panel into the lower pair of 2BA hank bushes on the front end of the i.f. unit.
- (4) Remove all leads from the tag board, the two screws holding the oscillator and the four pillars holding the tag board in position. Remove the tag board.
- (5) Unsolder the four leads to the oscillator.

Dismantling the Oscillator

14. (1) Remove the fixing screws from the front end of the case.
- (2) Pull the oscillator out of its case, noting the position of any insulation sheet which must be re-inserted on re-assembly.

REMOVAL OF 3 Mc/s RE-INSERTION OSCILLATOR

Removal of Oscillator Unit

15. (1) Remove the front panel as described in para. 3 above and disconnect leads to the oscillator.
- (2) Remove the two screws holding the oscillator to the dummy front panel.

Dismantling the Oscillator (See paras. 20 and 21 for Preset version)

16. (1) Remove the screws securing the cover to the frame.
- (2) Pull the oscillator out of the case, noting the position of any insulated sheeting which must be re-inserted on re-assembly.

REMOVAL OF B.F.O.

Removal of Oscillator Unit

17. Disconnect the leads to the oscillator and remove the two screws securing it to the side member.

Dismantling the Oscillator

18. (1) Remove the screws securing the end cover to the case and pull the cover off.
- (2) Remove the oscillator retaining screws from the case.
- (3) Pull the oscillator out of the case, noting the position of any

insulated sheeting which must be re-inserted on re-assembly.

REMOVAL OF AUDIO AMPLIFIER AND SQUELCH UNIT

19. The removal of either of these units entails the disconnection from the receiver wiring and removing of the fixing screws in the mounting pillars.

REMOVAL OF PRE-SET 3 Mc/s RE-INSERTION OSCILLATOR

Removal of Oscillator Unit

20. (1) Remove the front panel as described in para. 3 above and disconnect leads to the oscillator.
- (2) Remove the two screws holding the oscillator to the dummy front panel.

Dismantling the Oscillator

21. (1) Remove the screws securing the end cover to the case and pull the cover off.
- (2) Remove the oscillator retaining screws from the case.
- (3) Pull the oscillator out of the case, noting the position of any insulated sheeting, which must be re-inserted on re-assembly.

CHAPTER 3

INITIAL FAULT LOCATION

INTRODUCTION

1. For receivers with extended control see also the Fault Location chapters in LA.370 Extended Control Unit handbook.
2. The initial fault location is confined to the use of an Avo Model 8 or similar 20 000-ohms per volt multi-range instrument.
3. Unless otherwise stated, all voltages are measured with respect to the negative regulated supply line.

UNIT CHECKS

4. (1) Check that the mains transformer voltage adjustment is correct for the a.c. voltage in use for a.c. operation or when operating from a d.c. supply that earthed polarity is correct (see Sect. 1 Chap. 2, paras. 2-9).
- (2) Ensure that the correct 'r.f. plug-in boards' and crystals have been selected for each channel in use, and also that the crystals and boards are firmly in place.
- (3) Switch the POWER switch 'on' and check that the indicator lamp on the front panel lights.
- (4) After the receiver has been switched on for approximately 10 minutes, remove the crystal oven lid and check that the Oven Temperature Safety Trip is intact (see fig. 5) and also that the crystal oven block is commencing to heat up.

NOTE: If the Oven Temperature Safety Trip contact is broken, switch off the receiver at the POWER switch and repair the contact with WOODS METAL only.

- (5) Check each channel in turn for reception by the receiver against the carrier for the respective channel. Failure to operate on only one channel could be caused either by faulty 'plug-in board' or crystal, and replacements should be tried.
- (6) If only 'mush' can be obtained in either the S.S.B. and A.M. positions of the System switch, the presence of the i.f. signal at the detector can be verified by selecting C.W. operation and adjusting the B.F.O. control for a variable tone from the speaker or headphones.

WARNING: ALWAYS SWITCH THE RECEIVER OFF AT THE POWER SWITCH BEFORE APPLYING A SOLDERING IRON.

Symptom	Action	Possible Cause and Remarks
1. Indicator lamp remains extinguished and no h.t. supplies.	Check the supply voltage at the input to the power unit and the output volts.	Faulty POWER switch, fuses, short-circuited capacitors or a break in the wiring.
2. Indicator lamp lights, but no regulated or stabilised h.t. supplies.	Check the voltage at capacitor C4.	No voltage, series rectifier not conducting due to open circuit. Voltage correct, fault in fuse FS1-VT1 circuit.
3. 20 volt supply not regulating.	(a) Check that the voltage on the base of VT3 varies with the adjustment of potentiometer RV1. (b) Check that the voltage on VT3 emitter is approximately 8 volts negative relative to the positive line.	Small or no variation, check resistors R3, R4 and RV1. Variation satisfactory, proceed to test (b). If voltage is incorrect, check R2 and associated diodes. The voltage is correct, check transistors VT1, VT2 and VT3.
4. No (or in incorrect) +12V stabilised supply.	Check capacitor C3, resistor R1 and associated diodes.	There will be no output if the diodes or C3 are short-circuited, or R1 is open-circuit. If either of the diodes are open-circuit the supply voltage will be high.
5. No 20 volt supply at LA. 370 Extended Control Unit. (LOCAL-REMOTE switch in REMOTE position).	(a) Check from spill 5 to spill 10 (20 V) and to spill 1 (24V) on MA. 346 tagboard (see fig. 21). (b) Check for 20V from +ve line to MA. 346 socket pins for the following CHANNEL switch positions:- (i) Channels 1, 2, 3, & 4 pin 1.	No voltages, check for fault in +ve line to power unit. Voltage at one point only, check for wiring fault in the other lead. Satisfactory voltages, proceed to test (b). No voltage at any of the specified points, check for switching and wiring faults. Voltages satisfactory, proceed to test (c)

Symptom	Action	Possible Cause and Remarks
	(ii) Channels 5, 6 & 7 pin 2.	
	(iii) Channel 8 and Stand By pin 5.	
	(c) Check for 20V from spill 10 on tagboard to socket pin 6 for MA. 346.	No voltage, check for wiring faults. Voltage satisfactory, check for faults in connector to LA. 370.

CHAPTER 4

GENERAL FAULT LOCATION

INTRODUCTION

1. This procedure should only be carried out by competent personnel with suitable test equipment. If the necessary test equipment is not available, the receiver should be returned to the manufacturer.
2. Before carrying out the procedure outlined in this chapter, the Initial Fault Location in Chapter 3 of this section must be fulfilled.
3. The following procedure, whilst not comprehensive, is intended as an aid to the location of a fault. It should be noted that unless otherwise stated, the tests for a fault should be carried out in the order shown in the Fault Location Chart and that each test may be valid only if those preceding it (if any) in a series of tests have been performed.
4. Unless otherwise stated, all signal injection and output measurements are taken with respect to the chassis, and all voltage measurements with respect to the negative regulated supply line.
5. Care should be exercised when applying a soldering iron to transistors, diodes etc., and the use of a suitable heat shunt is advised.

WARNING: ALWAYS SWITCH THE RECEIVER OFF AT THE POWER SWITCH BEFORE APPLYING A SOLDERING IRON.

6. When making checks on the i.f. unit it may be necessary to remove this unit from the main chassis (see Sect. 2, Chap. 2, para. 6) to gain access to various test points. The unit can be temporarily fixed to the main chassis with two 2BA screws through the top two holes in the dummy front panel and the lower pair of 2BA hank bushes on the front end of the i.f. unit.

Symptom	Action	Possible Cause and Remarks
1. No Speaker output.	(a) Check the wiring between the Speaker and audio unit and also the Speaker speech coil for continuity.	No fault in Speaker or wiring proceed to test(b).
	(b) Check the regulated 20V supply to the audio unit between 4C28 -ve and 4C29 +ve (see Fig. 13 for the location of the components).	Supply voltage not at check point, check for fault in wiring. Supply voltage correct, proceed to test (c).
	(c) Switch the receiver off at the POWER switch. Connect the audio generator to 4VT1 base via two 25 μ F capacitors that are connected in series back-to-back, i. e. the two negatives connected together. Connect the output meter set to 15 Ω in place of resistor 4R30 and the SPEAKER switch (4SA) to the OFF position. Set the audio generator output to 2 mV r. m. s. at 1 kc/s sine-wave, connect the valve millivolt meter to the collector of 4VT1 and the A. F. GAIN to maximum (fully clock-wise). Switch the POWER on and check that the output meter reading is approx. 100 mW.	Output meter reading satisfactory, proceed to test 3 of this table to check for i. f. output. Low output, re-adjust pre-set potentiometers 4RV1 and 4RV2 as detailed in Sect. 2, Chap. 5, paras. 8, 9 and re-check output. If the output is still low proceed to test (d).
	(d) With a. f. unit in the same conditions as for test (c) above, monitor the signal levels with a valve millivolt-meter at the following points:-	No output, see test (f) if the receiver is fitted with a squelch unit. If there is no squelch unit, check d. c. voltages for the transistors as detailed in test (e).
		A low signal level could indicate a fault in the transistor, associated transistors or components, check the d. c. levels as in test (e).

Symptom	Action	Possible Cause and Remarks																																				
1. continued	4VT1 collector 60 mV r.m.s. 4VT2 collector 1V r.m.s. 4VT3 base 18.5 mV r.m.s. 4VT3 emitter 18 mV r.m.s. 4VT4 collector 1.8 V r.m.s. 4VT6 base 800 mV r.m.s. 4VT6 collector 1.35V r.m.s. 4VT7 emitter 1.75V r.m.s. (e) Check the d.c.levels with respect to the negative regulated supply line at each transistor under no signal conditions. A valve voltmeter is to be used for measuring the d.c.volts on 4VT1 and an Avo Model 8 can be used for the remaining transistors. The System switch must be in either the AM or CW position.	NOTE: If for any reason transistor 4VT1 is replaced, the replacement must be selected to produce a signal level of at least 60 mV r.m.s. for a 2 mV r.m.s.input at the base of 4VT1. The d.c.voltage should be within $\pm 10\%$ of the values detailed. If no fault has been found and the receiver incorporates a squelch unit, this unit may be faulty, see test (f).																																				
	<table><thead><tr><th></th><th>Collector</th><th>base</th><th>emitter</th></tr></thead><tbody><tr><td>4VT1</td><td>+18.2V</td><td>+1.2V</td><td>+ 0.77V</td></tr><tr><td>4VT2</td><td>+ 8.2V</td><td>+16.5V</td><td>+16.8V</td></tr><tr><td>4VT3</td><td>+11.8V</td><td>+17.5V</td><td>+18.3V</td></tr><tr><td>4VT4</td><td>+11.3V</td><td>+18.3V</td><td>+18.8V</td></tr><tr><td>4VT5</td><td>+0.75V</td><td>+ 9.7V</td><td>+10V</td></tr><tr><td>4VT6</td><td>+10.2V</td><td>+0.75V</td><td>+ 0.03V</td></tr><tr><td>4VT7</td><td>+20V</td><td>+11.3V</td><td>+10.8V</td></tr><tr><td>4VT8</td><td>+20V</td><td>+10.8V</td><td>+10V</td></tr></tbody></table>		Collector	base	emitter	4VT1	+18.2V	+1.2V	+ 0.77V	4VT2	+ 8.2V	+16.5V	+16.8V	4VT3	+11.8V	+17.5V	+18.3V	4VT4	+11.3V	+18.3V	+18.8V	4VT5	+0.75V	+ 9.7V	+10V	4VT6	+10.2V	+0.75V	+ 0.03V	4VT7	+20V	+11.3V	+10.8V	4VT8	+20V	+10.8V	+10V	
	Collector	base	emitter																																			
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4VT7	+20V	+11.3V	+10.8V																																			
4VT8	+20V	+10.8V	+10V																																			
	(f) Short-circuit relay contact 7RLA1 on the squelch unit and repeat test (c).	An output indicates a fault in the squelch unit or incorrect SQUELCH control setting. See test (g).																																				
	(g) Rotate the SQUELCH pre-set control 7RV1 over its full range and check that an output is obtained on the output meter.	Output obtained, check squelch sensitivity as detailed in test 2(d). No output, proceed to squelch tests in 2 below.																																				

Symptom	Action	Possible Cause and Remarks																
2. Squelch in-operative	(a) If the receiver output remains muted irrespective of the SQUELCH control position check the regulated 20 V supply between the junction of 7R7, 7RLA/1 and +ve of capacitor 7C3 on the squelch board (see Fig. 13). If the SQUELCH control will not mute the receiver output see test (c).	No supply voltage, check for fault in the wiring. Supply voltage correct proceed to test (b).																
	(b) Using the valve voltmeter check the d.c. levels with respect to the negative regulated supply at each transistor under no signal conditions.	The voltage values detailed are from a typical unit. Voltage departures, particularly base voltages that exceed $\pm 5\%$ should give a location to the fault.																
	<table><tr><td></td><td>collector</td><td>base</td><td>emitter</td></tr><tr><td>7VT1</td><td>+7.9V</td><td>+19V</td><td>+19.5V</td></tr><tr><td>7VT2</td><td>+4.6V</td><td>+7.8V</td><td>+8.1V</td></tr><tr><td>7VT3</td><td>+0.45V</td><td>+10.5V</td><td>+9.9V</td></tr></table>		collector	base	emitter	7VT1	+7.9V	+19V	+19.5V	7VT2	+4.6V	+7.8V	+8.1V	7VT3	+0.45V	+10.5V	+9.9V	If all voltages appear correct check the input circuit wiring and components comprising 7C1, 7C2 and 7RV1. If no fault is found proceed to test (c).
		collector	base	emitter														
	7VT1	+7.9V	+19V	+19.5V														
7VT2	+4.6V	+7.8V	+8.1V															
7VT3	+0.45V	+10.5V	+9.9V															
(c) Using an Avo Model 8, check the voltage between the collector and emitter for each transistor under no signal conditions.	Incorrect voltages should indicate the stage with the faulty component. See also test (f).																	
<table><tr><td>7VT1</td><td>7VT2</td><td>7VT3</td></tr><tr><td>12V</td><td>3.62V</td><td>9.45V</td></tr></table>	7VT1	7VT2	7VT3	12V	3.62V	9.45V												
7VT1	7VT2	7VT3																
12V	3.62V	9.45V																
(d) Switch the receiver off at the POWER switch. Connect the audio generator to 4VT1 base via two 25 μ F capacitors that are connected in series back-	SQUELCH control not providing adjustment of the detailed output range proceed to test (e).																	

Symptom	Action	Possible Cause and Remarks																
2. continued	<p>to-back i. e. the two negatives connected together.</p> <p>Connect the output meter set to 15Ω in place of resistor 4R30 and the SPEAKER switch (4SA) to the OFF position. Set the audio generator output to 2 mV r.m.s. at 1 kc/s sine wave, connect the valve millivolt-meter to the collector of 4VT1 and the A. F. GAIN to maximum (fully clockwise). Switch the POWER on and adjust the SQUELCH control 7RV1 to obtain an indication on the output meter (100 mW approx.). Check that careful adjustment of the SQUELCH control will break or apply the amplifier output to the output meter for levels between 10 mW and 250 mW. These output levels are obtained by re-adjustment of either the audio generator attenuator or the receiver's A. F. GAIN control.</p> <p>(e) Adjust the amplifier output to obtain an indicated 100 mW on the output meter. Carefully adjust the SQUELCH control so that slight rotation in either direction will make or break the output to the output meter. With the output indicated on the meter check the transistor d.c. levels using the valve voltmeter.</p> <table> <tr> <td></td> <td>collector</td> <td>base</td> <td>emitter</td> </tr> <tr> <td>7VT1</td> <td>+8.3V</td> <td>+19.5V</td> <td>+19.7V</td> </tr> <tr> <td>7VT2</td> <td>+2V*</td> <td>+8.3V</td> <td>+8.4V</td> </tr> <tr> <td>7VT3</td> <td>+5V*</td> <td>+8.6V</td> <td>+8.7V</td> </tr> </table> <p>* ± 0.5V can be expected.</p> <p>(f) With the unit under the signal conditions for test (e), check the voltage between the collector and emitter for each transistor</p>		collector	base	emitter	7VT1	+8.3V	+19.5V	+19.7V	7VT2	+2V*	+8.3V	+8.4V	7VT3	+5V*	+8.6V	+8.7V	<p>Base voltage departures greater than ± 5% should indicate the location of the fault. If no fault can be found proceed to test (f).</p> <p>If transistor 7VT1 is not conducting the unit relay should be de-energised. If VT3 is functioning</p>
	collector	base	emitter															
7VT1	+8.3V	+19.5V	+19.7V															
7VT2	+2V*	+8.3V	+8.4V															
7VT3	+5V*	+8.6V	+8.7V															

Symptom	Action	Possible Cause and Remarks
2. continued	using the Avo Model 8. <div> <div>7VT1</div> <div>11.7V</div> </div> <div> <div>7VT2</div> <div>6.3V</div> </div> <div> <div>7VT3</div> <div>4.55V</div> </div>	correctly, the removal of 7VT2 emitter should result in the relay being energised.
3. No. I. F. input to Detector	<p>(a) Check for fault in signal wiring between i. f. unit and audio unit.</p> <p>(b) Check d. c. supplies to i. f. unit from capacitor 2C34 -ve to 2C52 (20V) and also to 2C54 (12V). See Fig. 7 for component positions.</p> <p>(c) Check the a. g. c. voltage under no signal conditions, with R. F. GAIN control at maximum, between 2C54 and 2C34 +ve is approximately -2.5V.</p> <p>(d) Select the A. M. position of the System switch and a channel fitted with either a Range 3 or 4 R. F. Board. Locate the lead from relay contact 2RLA2 to the base of 2VT2 and inject via 0.1 μF capacitor a modulated 3 Mc/s signal at 10 mV approx. from the signal generator on this lead. Check that the modulation can be heard on the loudspeaker.</p> <p>(e) Check the signal path from the i. f. unit output transistor to the detector. Apply via 0.1 μF capacitor a modulated 3 Mc/s signal at 800 mV approx. from the signal generator to the junction 2C37 and 2VT6 collector, and check that the modulation is heard on the speaker.</p>	<p>No fault, proceed to test (b).</p> <p>Check for fault in wiring if no supply is available. Proceed to test (c) if voltages are correct.</p> <p>If voltage is correct, proceed to test (d). If voltage is incorrect, check for fault in a. g. c. amplifier stage and see also Sect. 2, Chap. 5, para. 7 for adjustment of a. g. c. voltage.</p> <p>If the modulation appears at the speaker, the fault is probably in either the R. F. unit or Channel Oscillator.</p> <p>No speaker output, see test (e).</p> <p>No output from the speaker check back towards the detector with the signal generator to locate the fault.</p> <p>See test (f) if loudspeaker output is obtained.</p>

Symptom	Action	Possible Cause and Remarks																				
3. continued	(f) Reduce the signal generator output as necessary to prevent limiting and check that the signal generator modulation can be obtained at the speaker from the stages between 2VT6 and 2VT2 by applying the signal generator output via a 0.1 μ F capacitor to the switch wafer 2SA1Fa wiper contact, base of 2VT4 and the junction of 2C12-2VT2 collector. Check the d. c. working voltages for transistors and also for faulty components of a stage that does not give the output at the speaker.	<p>The d. c. voltages for the transistors when measured with an AVO Model 8 should be within $\pm 10\%$.</p> <table><thead><tr><th></th><th>C</th><th>B</th><th>E</th></tr></thead><tbody><tr><td>2VT2</td><td>2.3</td><td>17.1</td><td>17.3</td></tr><tr><td>2VT4</td><td>0.44</td><td>11.0</td><td>11.25</td></tr><tr><td>2VT5</td><td>0.45</td><td>10.7</td><td>11.0</td></tr><tr><td>2VT6</td><td>0.6</td><td>17.9</td><td>18.25</td></tr></tbody></table>		C	B	E	2VT2	2.3	17.1	17.3	2VT4	0.44	11.0	11.25	2VT5	0.45	10.7	11.0	2VT6	0.6	17.9	18.25
	C	B	E																			
2VT2	2.3	17.1	17.3																			
2VT4	0.44	11.0	11.25																			
2VT5	0.45	10.7	11.0																			
2VT6	0.6	17.9	18.25																			
4. A. G. C. voltage incorrect and cannot be reset to correct value.	Check d. c. voltages of transistors 2VT7, 2VT8 and 2VT9 with the R. F. Gain control at maximum.	<p>D. C. voltages $\pm 10\%$</p> <table><thead><tr><th></th><th>C</th><th>B</th><th>E</th></tr></thead><tbody><tr><td>2VT7</td><td>12.6</td><td>14.8</td><td>16.25</td></tr><tr><td>2VT8</td><td>19.3</td><td>12.6</td><td>12.1</td></tr><tr><td>2VT9</td><td>12.6</td><td>5.25</td><td>5.0</td></tr></tbody></table> <p>Fault could be in either the input or output to the a. g. c. amplifier.</p>		C	B	E	2VT7	12.6	14.8	16.25	2VT8	19.3	12.6	12.1	2VT9	12.6	5.25	5.0				
	C	B	E																			
2VT7	12.6	14.8	16.25																			
2VT8	19.3	12.6	12.1																			
2VT9	12.6	5.25	5.0																			
5. No output with channel signals at the aerial socket.	(a) Apply a 100 mV. 30% modulated signal at the frequency of the selected channel from the signal generator to the base of 1VT3 via a 0.1 μ F capacitor and check that the signal generator modulation can be heard at the speaker.	<p>Output at speaker, proceed to test (b). No speaker output, check d. c. voltages at 1VT2 and 1VT3 are correct within $\pm 10\%$.</p> <table><thead><tr><th></th><th>C</th><th>B</th><th>E</th></tr></thead><tbody><tr><td>1VT2</td><td>0.16</td><td>10.5</td><td>10.8</td></tr><tr><td>1VT3</td><td>1.2</td><td>10.8</td><td>11.0</td></tr></tbody></table> <p>If no fault can be found at 1VT2 and 1VT3, the fault might be in the Channel Oscillator. See test (c).</p>		C	B	E	1VT2	0.16	10.5	10.8	1VT3	1.2	10.8	11.0								
	C	B	E																			
1VT2	0.16	10.5	10.8																			
1VT3	1.2	10.8	11.0																			
	(b) Transfer signal generator (output 150 mV) and capacitor to the base of 1VT1 and re-check for output at the speaker.	<p>Output obtained, the fault should be between the aerial socket and base of 1VT1.</p>																				

Symptom	Action	Possible Cause and Remarks
5. continued		No output, check d.c. voltages for 1VT1 with an AVO Model 8. Tolerance $\pm 10\%$. collector base emitter 0.45V 10.8V 1.0V
	(c) Check with the valve voltmeter that Channel Oscillator r.f. output is approx. 2.2V at 2.2 Mc/s and 920 mV at 21 Mc/s.	No channel oscillator r.f. output, check the d.c. working conditions of transistors 3VT1 and 3VT2 with collector base emitter 4.0V 11.3V 11.4V
6. Receiver not operating on channel frequencies between 1.5 and 7 Mc/s.	(a) Check that the 3.7 Mc/s output is approx. 1.2V r.m.s. on the valve voltmeter and also that relay contact 2RLA2 has selected coil 2L1.	Satisfactory output fault may be in base circuit of 2VT2. No output, proceed to test (b).
	(b) Check from the positive regulated supply line to the negative supply points on the relay coil 2RLA/2 and 3.7 Mc/s oscillator.	No supply, check for faulty wiring. 20 volt supply correct, proceed to test (c).
	(c) Check the d.c. condition at transistors 2VT1 and 2VT3 with AVO Model 8. Prevent the oscillator from oscillating by disconnecting one of the crystal pins.	Voltage variations greater than 10% could indicate the location of a faulty component or transistor.
	collector base emitter 5.9V 11.3V 11.4V	
7. Receiver not operating on channel frequencies between 7 and 14 Mc/s.	Check that transistor 2VT10 is conducting by measuring d.c. voltages with the valve voltmeter and also that relays 2RLB/2 and 2RLC/2 are de-energised.	The d.c. voltages at 2VT10 should be: collector base emitter 800 mV 1.5V 700 mV

Symptom	Action	Possible Cause and Remarks
8. Receiver not operating on channel frequencies between 14 and 24 Mc/s.	<p>(a) Check from the positive line to the +ve of 2MR7 for -20V.</p> <p>(b) Check that relay contact 2RLA2 has selected coil 2L2.</p>	<p>No volts, fault may be in board or the wiring.</p> <p>Satisfactory volts proceed to test (b).</p>
9. Receiver not operating on S. S. B. or TUNE. (See 11 below for alternative if pre-set version of 3 Mc/s re-insertion oscillator is used).	<p>(a) Check that the 20V d. c. supply is being applied to the 3 Mc/s re-insertion oscillator when the System switch is in either of the S. S. B. and TUNE positions also check with a valve voltmeter that this oscillator output at 3 Mc/s is approx. 1V r. m. s.</p> <p>(b) Check with the AVO 8 connected to pin F on the re-insertion oscillator that when the CLARIFIER control is varied the voltage reading also varies.</p> <p>(c) Check the d. c. conditions at transistor 5VT1 with valve voltmeter. Disconnect one of the crystal pins to prevent oscillator from oscillating.</p> <p>Collector-emitter 0.85V approx. Collector-base 0.2V approx.</p>	<p>Satisfactory output, check for wiring or component faults to the detector stage in the a. f. unit.</p> <p>No output, proceed to test (b).</p> <p>Voltage variation proceed to test (c).</p> <p>Test unsatisfactory, fault in potentiometer or wiring.</p>
10. Receiver not operating on C. W.	Check that the 20V d. c. supply is applied to the B. F. O. when the C. W. position of the System switch is selected also monitor the output from the B. F. O. with an oscilloscope to check the output is approx. 800 mV peak-to-peak.	If the output from the B. F. O. is satisfactory, check for the signal at the a. f. unit.

Symptom	Action	Possible Cause and Remarks						
11. Pre-set version of 3 Mc/s carrier re-insertion oscillator (alternative to 9 above).	<p>(a) Check that the 20V d. c. supply is being applied to the Preset 3 Mc/s re-insertion oscillator when the System switch is in either of the S. S. B. and TUNE positions also check with a valve voltmeter that this oscillator output at 3 Mc/s is approx. 1V r. m. s.</p> <p>(b) Check the d. c. conditions at transistors 5VT1 and 5VT2 with AVO model 8. Disconnect one of the crystal pins to prevent the oscillator from oscillating.</p> <table> <tr> <td>collector</td><td>base</td><td>emitter</td></tr> <tr> <td>5.9V</td><td>11.3V</td><td>11.4V</td></tr> </table>	collector	base	emitter	5.9V	11.3V	11.4V	<p>Satisfactory output, check for wiring or component faults to the detector stage in the a. f. unit.</p> <p>Voltage variations greater than 10% could indicate the location of a faulty component or transistor.</p>
collector	base	emitter						
5.9V	11.3V	11.4V						

CHAPTER 5

RE - ALIGNMENT

INTRODUCTION

1. This procedure should only be carried out by competent personnel with suitable test equipment. If the necessary test equipment is not available for any procedure detailed in this chapter, the receiver should be returned to the manufacturer.
2. Unless otherwise stated, all signal injection and output measurements are taken with respect to the chassis, and all voltage measurements with respect to the negative regulated supply line.
3. Always switch the receiver off at the POWER switch before using a soldering iron on the unit. Care should be exercised when it is necessary to apply a soldering iron to transistors and diodes, and the use of a suitable heat shunt is advised.
4. When monitoring the signal generator frequency output with the frequency meter, the high unattenuated output on the signal generator is connected to the frequency meter. No alignment procedure has been included for the Channel Oscillator Crystal Oven, the L-C crystal filter, the U.S.B. and L.S.B. filters and if it is considered necessary for any of these to be re-aligned, the receiver should be returned to the manufacturer.

INITIAL CHECKS

5. Before commencing any re-alignment of a sub-unit in the receiver, check that the regulated supply is $20V \pm 0.2V$, the stabilised supply is $+12.5V \pm 0.5V$ relative to the negative line of the regulated supply and that there is a 24V unregulated supply to the crystal oven. Also check that under no signal conditions with the R.F. GAIN control set to maximum that the a.g.c. voltage is $-2.3V$ relative to the $+12V$ stabilised supply. (A.G.C. check point).

20 VOLT REGULATED SUPPLY RE-ADJUSTMENT

6. (1) Connect the AVO Model 8 to the 20 volt stand-off insulators on the power unit (see figs. 15, 17 and 19).
- (2) Carefully adjust the pre-set potentiometer on the power unit bracket until the meter reading is 20 volts.

ADJUSTMENT OF A.G.C.

7. (1) Set the R.F. GAIN control (2RV3) to maximum (extreme clockwise position). Connect the AVO Model 8 between the $+12$ volt stabilised supply (positive meter lead) and the wiper tag of the R.F. GAIN control. Connect a $0.1\mu F$ capacitor between chassis and base of 2VT2.
- (2) With no signal input to the receiver, adjust pre-set potentiometer

2RV2 to give a 2.5 volt reading and then adjust potentiometer 2RV1 until a 2.3 volt reading is obtained. See figure 24 for location of pre-set potentiometers.

A. F. OUTPUT TRANSISTORS D. C. BALANCE AND QUIESCENT CURRENT

8. (1) Switch the receiver OFF at the POWER switch.
- (2) Set A. F. GAIN control 4RV3 to minimum for no signal condition.
- (3) Connect the AVO Model 8 to the junction of resistor 4R28 and 4VT6 collector and the negative regulated supply line. (see fig. 13). Switch the receiver ON at the POWER switch and adjust 4RV1 to obtain a 10V reading on the meter. Remove the meter after this adjustment.
- (4) Check the d. c. current through resistor 4R27 by setting the AVO Model 8 to the 50 μ A d. c. position and connecting it across this resistor.
- (5) The indication on the scale should lie between 6 and 7 on 0-25 scale. Adjust control 4RV2 as necessary to obtain a reading within these limits. The current through 4R27 will be 15 mA \pm 1 mA under these conditions.
- (6) Repeat operations (3) to (5) as required to obtain satisfactory results.

A. F. UNIT SYMMETRICAL BALANCE

9. The a. f. output transistors d. c. balance and quiescent current operations in paragraph 8 must be carried out prior to the procedure detailed below.
 - (1) Switch off the receiver at the POWER switch, and connect the audio generator to 4VT1 base via two 25 μ F capacitors that are connected in series back to back i. e. the two negatives connected together.
 - (2) Connect the oscilloscope to the PHONE jack output and select 1 kc/s sine wave on the audio generator.
 - (3) Set the A. F. GAIN control to maximum and switch on the receiver at the POWER switch.
 - (4) Increase the audio generator output until clipping of the waveform can be seen on the oscilloscope and adjust control 4RV1 as necessary to bring the clipping symmetrical.
 - (5) Set the POWER switch to OFF and remove the oscilloscope, audio generator and capacitors.

3 Mc/s CARRIER RE-INSERTION OSCILLATOR RE-ALIGNMENT

NOTE: See para. 15 for re-alignment of pre-set version.

10. (1) Switch the receiver off at the POWER switch.
- (2) Connect the signal generator to the base of 1VT3 via a 0.1 μ F

capacitor and select a channel on the receiver's CHANNEL switch within the frequency range of 14 to 24 Mc/s.

- (3) Remove the Channel oscillator input to transistor 1VT2 by disconnecting capacitor 1C18 from the connection to resistors 1R4 and 1R6 and connect the free end of 1C18 to the chassis.
- (4) Set the signal generator output frequency accurately to 3Mc/s. ± 5 c/s unmodulated with the aid of the frequency meter and an output level of 500 μ V.
- (5) Select the TUNE position on the receiver System switch and set the R. F. and A. F. GAIN controls to maximum.
- (6) Switch the receiver POWER switch to ON and adjust the CLARIFIER control for zero beat.

NOTE: The frequency meter can be transferred to the receiver PHONE jack to check that the zero beat is within ± 5 c/s.

- (7) Connect the low capacity probe on the valve voltmeter to the oscillator output tag and carefully adjust the core at the rear of the oscillator with a non-metallic screwdriver for maximum indicated output on the valve voltmeter.
- (8) Re-check for zero beat and adjust the CLARIFIER control if necessary.
- (9) Repeat operations (7) and (8) for optimum results. The indication on the CLARIFIER control knob should be vertical for zero beat, loosen the knob on the control spindle and re-position the knob as required to bring the indication vertical for zero beat.
- (10) Set the receiver POWER switch to OFF, disconnect the valve voltmeter, signal generator and 0.1 μ F capacitor. Re-connect capacitor 1C18 to resistor junction 1R4, 1R6.

B. F. O. RE-ALIGNMENT

11. (1) Switch off the receiver at the POWER switch.
- (2) connect the signal generator to the base of 1VT3 via a 0.1 μ F capacitor and select a channel on the receiver's CHANNEL switch within the frequency range of 14 to 24 Mc/s.
- (3) Remove the Channel oscillator input to transistor 1VT2 by disconnecting capacitor 1C18 from the connection to resistors 1R4 and 1R6 and connect the free end of 1C18 to the chassis.
- (4) Select the TUNE position of the System on the receiver and connect the frequency meter to the PHONES output jack socket.
- (5) Adjust the signal generator output level to 500 μ V and the frequency to 3 Mc/s with the modulation off.

- (6) Switch the receiver POWER on and set the R. F. GAIN and A. F. GAIN controls to maximum. Carefully adjust the signal generator frequency for zero beat.

NOTE: The 3 Mc/s Carrier Re-Insertion Oscillator must be known to be accurately aligned (see para. 10 in this chapter).

- (7) Set the B. F. O. control to its extreme clockwise position and the System switch to C. W.
- (8) Adjust the core of 8L1 with a non-metallic screwdriver, through the hole provided in the underside edge of the side member, until a frequency of $3.6 \text{ kc/s} \pm 100 \text{ c/s}$ is obtained on the frequency meter.
- (9) Check that when the B. F. O. control is turned to its extreme anti-clockwise position, the change in frequency on the frequency meter is not less than 8 kc/s having gone through zero frequency.
- (10) Set the POWER switch to OFF and re-connect 1C18 to resistors 1R4 and 1R6 junction. Disconnect the signal generator and capacitor and frequency meter from the PHONES jack.

3.7 Mc/s OSCILLATOR RE-ALIGNMENT

12. (1) Switch the Receiver off at the POWER switch.
- (2) Obtain access to the 3.7 Mc/s Oscillator as described in Section 2, Chapter 2, paragraphs 13(1) to 13(3) but do not disconnect leads or remove oscillator from board.
- (3) Remove Channel oscillator input to transistor 1VT2 by disconnecting capacitor 1C18 from the connection to resistors 1R4 and 1R6 and connect the free end of 1C18 to the chassis.
- (4) Connect the signal generator to the base of 1VT3 via a $0.1 \mu\text{F}$ capacitor and select a channel on the CHANNEL switch that is within the range of 1.5 to 7 Mc/s.
- (5) Set the signal generator frequency to 700 kc/s unmodulated with the aid of the frequency meter and select the AM position on the System switch.
- (6) Set the signal generator output level to $500 \mu\text{V}$ and transfer the frequency meter to collector of 2VT6.
- (7) Switch the POWER switch on and adjust the 3.7 Mc/s Oscillator for a reading of $3000 \text{ kc/s} \pm 5 \text{ c/s}$ on the frequency meter.
- (8) Set the POWER switch to OFF and re-connect 1C18 to junction of 1R4 and 1R6. Remove the frequency meter, signal generator and capacitor.

I. F. RE-ALIGNMENT

13. (1) Switch the receiver POWER off.

- (2) To obtain access to various alignment positions it is necessary to remove the i.f. unit from the main chassis as described in Section 2, Chapter 2, paragraph 6, but no disconnection of the leads to the i.f. units is necessary. The unit can be temporarily fixed to the main chassis with two 2BA screws through the two top holes in the dummy front panel and the lower pair of 2BA hank bushes on the front end of the i.f. unit.
- (3) Remove the Channel oscillator input to transistor 1VT2 by disconnecting capacitor 1C18 from the connection to resistors 1R4 and 1R6 and connect the free end of 1C18 to chassis.
- (4) Connect the signal generator to the base of 1VT3 via a 0.1 μ F capacitor, the valve voltmeter to collector of 2VT6 and the output meter in place of resistor 4R30 on the a.f. unit.
- (5) Select the TUNE position of the System switch, a suitable channel within 14 to 24 Mc/s on the CHANNEL switch, SPEAKER switch ON and R.F. and A.F. GAIN controls to maximum.

NOTE: The 3 Mc/s Carrier Re-Insertion Oscillator must be known to be accurately aligned (see para. 10 in this chapter).

- (6) Switch the receiver on at the POWER switch and set the signal generator output to 500 μ V with the modulation off and adjust the frequency output to produce a zero beat note at 3 Mc/s.
- (7) Select the A. M. position on the System switch and carefully adjust with a non-metallic screwdriver the cores of coils 1L5, 2L2, 2L5, 2L8, 2L9 and 2L10 as necessary for maximum output on the valve voltmeter.
- (8) Remove the valve voltmeter and select the signal generator modulation of 1 kc/s at 30%. Set the SPEAKER to OFF.
- (9) Adjust the core of 4L1 in the a.f. unit for maximum output on the output meter and re-check the adjustment of 2L10. Remove the output meter and re-connect 4R30.
- (10) Select the TUNE position of the System switch, switch the SPEAKER to ON and the CHANNEL switch to a channel within the frequency range of 1.5 to 7 Mc/s.
- (11) Reconnect the valve voltmeter to the 2VT6 collector and adjust the signal generator frequency (modulation off) for a zero beat at 700 kc/s.

NOTE: The 3.7 Mc/s Oscillator must be known to be accurately aligned (see para. 12 of this chapter).

- (12) Reset the System switch to A. M. and adjust the cores of coils 1L4 and 2L1 for maximum output on the valve voltmeter.

- (13) Change the signal generator frequency to 3 Mc/s and adjust the core of 1L21 for minimum indication on the valve voltmeter.
- (14) Adjust the core of 1L22 for minimum output on the valve voltmeter with a signal generator output frequency of 4.4 Mc/s.
- (15) Set the POWER switch to OFF and reconnect 1C18 to its original position. Remove the valve voltmeter, signal generator and capacitor.

TO CHANGE THE FREQUENCY OF A CHANNEL

14. (1) Select r.f. plug-in board that is suitable for the new channel frequency and insert this into the appropriate channel socket in the r.f. unit (see figs. 23 and 24).
- (2) Select a crystal that has a frequency that is either 700 kc/s above the new channel frequency for the signal frequency range from 1.5 to 7 Mc/s, 3 Mc/s above the new channel frequency for the signal frequency range from 7 to 14 Mc/s or 3 Mc/s below the new channel frequency for the signal frequency range from 14 to 24 Mc/s. Plug this crystal into the appropriate channel position on the channel oscillator crystal oven (see fig. 24).
- (3) Connect the signal generator to the aerial input of the receiver. Set the signal generator frequency to new channel frequency with the aid of frequency meter, the modulation off and the output level at 100 mV.
- (4) Set the System switch to TUNE, the CHANNEL switch to the channel that is being changed in frequency, the R.F. GAIN, A.F. GAIN and SQUELCH controls to maximum, the CLARIFIER knob indication vertical and the POWER switch to ON.
- (5) Allow at least an hour for the channel crystal in the oven to stabilize, refer to figure 24, and adjust the appropriate trimmer (3C5-3C12) on the Channel oscillator for zero beat.
- (6) Monitor the a.g.c. voltage with the AVO Model 8 connected to A.G.C. CHECK point, for location see Figure 3. Select the A. M. position on the System switch.
- (7) Refer to figure 2 and adjust the trimmer capacitors on the relevant plug-in r.f. board for minimum indication on the meter and attenuate the signal generator output level as necessary as the r.f. board is brought into tune. The coil cores should not normally need re-adjustment, if any core adjustment is necessary, it should be very slight if the trimmer capacitors have been correctly set.

NOTE: The position of the coil cores in the plug-in r.f. boards is important for optimum signal-noise conditions. The top of a core should be approximately level with the top of the coil former.

- (8) A slight final re-adjustment of the trimmer capacitors adjusted in operations (5) and (7) may be necessary to obtain optimum results from a transmitted pilot carrier.
- (9) Set the POWER switch to OFF and remove test equipment from the receiver.

PRESET 3 Mc/s CARRIER RE-INSERTION OSCILLATOR RE-ALIGNMENT

15. (1) Switch the receiver off at the MAINS (POWER) switch.
- (2) Connect the signal generator to the base of 1VT3 via a 0.1 μ F capacitor and select a channel on the receiver's CHANNEL switch within the frequency range of 14 to 24 Mc/s.
- (3) Remove the Channel oscillator input to transistor 1VT2 by disconnecting capacitor 1C18 from the connection to resistors 1R4 and 1R6 and connect the free end of 1C18 to the chassis.
- (4) Set the signal generator output frequency accurately to 3 Mc/s unmodulated with the aid of the frequency meter and select the TUNE position on the System switch.
- (5) Adjust the signal generator output level to 500 μ V.
- (6) Switch on the receiver MAINS (POWER) switch and adjust the CLARIFIER control for zero beat with an insulated screwdriver.
- (7) Set the MAINS (POWER) switch to OFF and reconnect 1C18 to resistor junction 1R4, 1R6. Disconnect the signal generator and capacitor.

CHAPTER 6

COMPONENTS LIST

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Orders for Spare Parts

In order to expedite handling of spare part orders, please quote:-

- (1) Type and serial number of equipment.
- (2) Circuit reference, description and manufacturer of part required.
- (3) Quantity required.

Joint-Service Numbers

(also known as CCA or NATO Stock Numbers)

Commercial and private users will note that the above numbers have been included in this section; these are for assisting Service users in the provision of spare components.

NOTES ON COMPONENT CHANGES AND ADDITIONS

[illegible]

Cct. Ref.	Value	Description	Rat.	Tol. %	N. A. T. O. No.	Manufacturer
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R. F. UNIT

Note: All component references are Prefixed 1.

	Ohms	RESISTORS		5905-99-		
R1	33	Composition	0.1W 10			Erie 15
R2	1.8K	Composition	0.1W 10	012-1653		Erie 15
R3	470	Composition	0.1W 10	012-1632		Erie 15
R4	10K	Composition	0.1W 10	012-1680		Erie 15
R5	33	Composition	0.1W 10			Erie 15
R6	10K	Composition	0.1W 10	012-1680		Erie 15
R7	10K	Composition	0.1W 10	012-1680		Erie 15
R8	1.8K	Composition	0.1W 10	012-1653		Erie 15
R9	100	Composition	0.1W 10	012-1608		Erie 15
R10	100	Composition	0.1W 10	012-1608		Erie 15
R11	470	Composition	0.1W 10	012-1632		Erie 15
R12	47K	Composition	0.1W 10	012-1704		Erie 15
R13	470	Composition	0.1W 10	012-1632		Erie 15
R14	100	Composition	0.1W 10	012-1608		Erie 15
R15		See Range 1 Board (1.5 to 3.25 Mc/s)				
R16		See Range 2 Board (3.25 to 7 Mc/s)				
R17		See Range 3 Board (7 to 14 Mc/s)				
R18		See Range 4 Board (14 to 24 Mc/s)				
R19		See Range 2 Board (3.25 to 7 Mc/s)				
R20		See Range 3 Board (7 to 14 Mc/s)				
R21	10	Composition	0.1W 10			Erie 15
		CAPACITORS		5910-99-		
C1		See Range 1 Board (1.5 to 3.25 Mc/s)				
C2		See Range 1 Board (1.5 to 3.25 Mc/s)				
C3	.047uF	Plastic Film	30V 20			Mullard C280AA/P47K
C4	.047uF	Plastic Film	30V 20			Mullard C280AA/P47K
C5		See Range 1 Board (1.5 to 3.25 Mc/s)				
C6	.047uF	Plastic Film	30V 20			Mullard C280AA/P47K
C7	100pF	Silver Mica	350V 2			Erie EDM-15/500V
C8	220pF	Silver Mica	350V 2			Erie EDM-15/500V
C9	.047uF	Plastic Film	30V 20			Mullard C280AA/P47K
C10	.047uF	Plastic Film	30V 20			Mullard C280AA/P47K
C11	.047uF	Plastic Film	30V 20			Mullard C280AA/P47K
C12	.047uF	Plastic Film	30V 20			Mullard C280AA/P47K
C13	.047uF	Plastic Film	30V 20			Mullard C280AA/P47K
C14	220pF	Polystyrene	125V 2			Salford PF
C15	180pF	Polystyrene	125V 2			Salford PF
C16	.047uF	Plastic Film	30V 20			Mullard C280AA/P47K

Cct. Ref.	Value	Description	Rat.	Tol. %	N. A. T. O. No.	Manufacturer
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R. F. UNIT (Continued)

CAPACITORS (Continued) 5910-99-

C17	150pF	Silver Mica	350V	2		S. T. & C. 454/LWA/51
C18	10pF	Ceramic P100	750V	$\frac{1}{2}$ pF	011-8348	Erie P100-A
C19	4.7pF	Ceramic P100	750V	$\frac{1}{2}$ pF	011-8344	Erie P100-A
C20	2.2pF	Ceramic P100	750V	$\frac{1}{2}$ pF	011-8340	Erie P100-A
C21	120pF	Polystyrene	125V	2		Salford PF
C22	120pF	Polystyrene	125V	2		Salford PF
C23		See Range 2 Board (3.25 to 7 Mc/s)				
C24		See Range 2 Board (3.25 to 7 Mc/s)				
C25		See Range 2 Board (3.25 to 7 Mc/s)				
C26		See Range 2 Board (3.25 to 7 Mc/s)				
C27		See Range 3 Board (7 to 14 Mc/s)				
C28		See Range 3 Board (7 to 14 Mc/s)				
C29		See Range 3 Board (7 to 14 Mc/s)				
C30		See Range 4 Board (14 to 24 Mc/s)				
C31		See Range 4 Board (14 to 24 Mc/s)				
C32		See Range 4 Board (14 to 24 Mc/s)				

INDUCTORS

L1	See Range 1 Board (1.5 to 3.25 Mc/s)	
L2	See Range 1 Board (1.5 to 3.25 Mc/s)	
L3	See Range 1 Board (1.5 to 3.25 Mc/s)	
L4	700 Kc/s Coil Assy.	Racal AA25335
L5	3 Mc/s Coil Assy.	Racal BA25336
L6	See Range 1 Board (1.5 to 3.25 Mc/s)	
L7	See Range 1 Board (1.5 to 3.25 Mc/s)	
L8	See Range 1 Board (1.5 to 3.25 Mc/s)	
L9	See Range 2 Board (3.25 to 7 Mc/s)	
L10	See Range 2 Board (3.25 to 7 Mc/s)	
L11	See Range 2 Board (3.25 to 7 Mc/s)	
L12	See Range 2 Board (3.25 to 7 Mc/s)	
L13	See Range 2 Board (3.25 to 7 Mc/s)	
L14	See Range 2 Board (3.25 to 7 Mc/s)	
L15	See Range 3 Board (7 to 14 Mc/s)	
L16	See Range 3 Board (7 to 14 Mc/s)	
L17	See Range 3 Board (7 to 14 Mc/s)	
L18	See Range 4 Board (14 to 24 Mc/s)	
L19	See Range 4 Board (14 to 24 Mc/s)	
L20	See Range 4 Board (14 to 24 Mc/s)	
L21	3 Mc/s Coil Assy.	Racal BA25333
L22	4.4 Mc/s Coil Assy.	Racal BA25334

Cct. Ref.	Value	Description	Rat.	Tol. %	N. A. T. O. No.	Manufacturer
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R. F. UNIT (Continued)

SWITCHES

SA		9 pole Channel Switch				Racal BSW33188
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TRANSISTORS

VT1		Germanium PNP				Philco 2N2360
VT2		Germanium PNP				Philco 2N2360
VT3		Germanium PNP				Philco 2N2360

DIODES

MR1		Germanium Gold Bonded				Mullard AAZ15
MR2		Silicon Junction				Mullard OA200
MR3		Silicon Junction				Mullard OA200
MR4		Silicon Junction				Mullard OA200

SOCKETS

SKT1		Co-axial				UG910A/U
SKT2- SKT9		24 pole				Continental Conn. IP57611HA24

RELAYS

RLA/2		Muting, 2CO				C. P. Clare Type F
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MISCELLANEOUS

Range 1 R. F. Board (1.5 to 3.25 Mc/s)						Racal AA25170 or AA37065
Range 2 R. F. Board (3.25 to 7 Mc/s)						Racal AA25171 or AA37066
Range 3 R. F. Board (7 to 14 Mc/s)						Racal AA24842
Range 4 R. F. Board (14 to 24 Mc/s)						Racal AA24841

RANGE 1 R. F. BOARD (1.5 to 3.25 Mc/s)

Note: All component references Prefixed 1

RESISTORS

R15	6.8K	Composition	0.1W	2		Erie N6
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CAPACITORS 5910-99-

C1A	190pF or 275pF	Ganged Variable				Plessey Type 27
C1B	190pF or 275pF	Part of C1A				Mullard Type 1034

Cct. Ref.	Value	Description	Rat.	Tol. %	N. A. T. O. No.	Manufacturer
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RANGE 1 R.F. BOARD (Continued)

CAPACITORS (Continued) 5910-99-

C2	3.3pF 190pF	Ceramic P100	750V	$\frac{1}{2}$ pF	011-8432	Erie P100-A Plessey Type 27
C5A	or 275pF	Ganged Variable				Mullard Type 1034
C5B	190pF or 275pF	Part of C5A				

INDUCTORS

L1		Coil Assy. 1.5 to 3.25 Mc/s				Racal CT25162
L2		Coil Assy. 1.5 to 3.25 Mc/s				Racal CT25163
L3		Coil Assy. 1.5 to 3.25 Mc/s				Racal CT25164
L6		Coil Assy. 1.5 to 3.25 Mc/s				Racal CT25163
L7		Choke				Racal CT26636
L8		Choke				Racal CT26637

RANGE 2 R.F. BOARD (3.25 to 7 Mc/s)

Note: All component references Prefixed 1

RESISTORS

R16	6.8K	Composition	0.1W	2		Erie N6
R19	18K	Composition	0.1W	2		Erie N6

CAPACITORS 5910-99-

	190pF					Plessey Type 27
C23A	or 275pF	Ganged Variable				Mullard Type 1034
C23B	190pF or 275pF	Part of C23A				
	190pF					Plessey Type 27
C24A	or 275pF	Ganged Variable				Mullard Type 1034
C24B	190pF or 275pF	Part of C24A				
C25	2.2pF	Ceramic P100	750V	$\frac{1}{2}$ pF	011-8340	Erie P100-A
C26	3.3pF	Ceramic P100	750V	$\frac{1}{2}$ pF	011-8342	Erie P100-A

INDUCTORS

L9		Coil Assy. 3.25 to 7 Mc/s				Racal CT25166
L10		Coil Assy. 3.25 to 7 Mc/s				Racal CT25167
L11		Coil Assy. 3.25 to 7 Mc/s				Racal CT25168
L12		Coil Assy. 3.25 to 7 Mc/s				Racal CT25167

Cct. Ref.	Value	Description	Rat.	Tol. %	N. A. T. O. No.	Manufacturer
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RANGE 2 R.F. BOARD (Continued)

INDUCTORS (Continued)

L13		Choke				Racal CT26638
L14		Choke				Racal CT26639

RANGE 3 R.F. BOARD (7 to 14 Mc/s)

Note: All component references Prefixed 1

RESISTORS

R17	6.8K	Composition	0.1W	2		Erie N6
R20	22K	Composition	0.1W	2		Erie N6

CAPACITORS

C27	65pF	Trimmer				Oxley A7/65
C28	65pF	Trimmer				Oxley A7/65
C29	65pF	Trimmer				Oxley A7/65

INDUCTORS

L15		Coil Assy. 7 to 14 Mc/s				Racal CT24846
L16		Coil Assy. 7 to 14 Mc/s				Racal CT24847
L17		Coil Assy. 7 to 14 Mc/s				Racal CT24848

RANGE 4 R.F. BOARD (14 to 24 Mc/s)

Note: All component references Prefixed 1

RESISTORS

R18	10K	Composition	0.1W	2		Erie N6
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CAPACITORS

C30	65pF	Trimmer				Oxley A7/65
C31	65pF	Trimmer				Oxley A7/65
C32	65pF	Trimmer				Oxley A7/65

INDUCTORS

L18		Coil Assy. 14 to 24 Mc/s				Racal CT24843
L19		Coil Assy. 14 to 24 Mc/s				Racal CT24844
L20		Coil Assy. 14 to 24 Mc/s				Racal CT24845

CHANNEL OSC. AND CRYSTAL OVEN

Note: All component references Prefixed 3

RESISTORS

R1	10K	Composition	0.1W	10	5905-99-012-1680	Erie 15
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Cct. Ref.	Value	Description	Rat.	Tol. %	N. A. T. O. No.	Manufacturer
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CHANNEL OSC. AND CRYSTAL OVEN (Continued)

RESISTORS (Continued) 5905-99-

R2	4.7K	Wirewound	1.5W	5	011-3271	Welwyn AW3101
R3	6.8K	Composition	0.1W	10	012-1674	Erie 15
R4	1K	Composition	0.1W	10	012-1644	Erie 15
R5	2.2K	Composition	0.1W	10	012-1656	Erie 15
R6	6.8K	Composition	0.1W	10	012-1674	Erie 15
R7	2.2K	Wirewound	1.5W	5	011-3263	Welwyn AW3101
R8	820	Composition	0.1W	10	012-1641	Erie 15
R9	1K	Composition	0.1W	10	012-1644	Erie 15
R10	2.2K	Composition	0.1W	10	012-1656	Erie 15
R11	6.8K	Composition	0.1W	10	012-1674	Erie 15
R12	6.8K	Composition	0.1W	10	012-1674	Erie 15
R13	1.5K	Wirewound	1.5W	5	011-3259	Welwyn AW3101
R14	10K	Composition	0.1W	10	012-1680	Erie 15
R15	1.5K	Composition	0.1W	10	012-1650	Erie 15
R16	1.0	Wirewound	1.5W	10	011-3195	Welwyn AW3101

POTENTIOMETERS

RV1	1K				Painton Bourne 2245-1-102
RV2	5K				Plessey Type G, Mk.5A

CAPACITORS

C1		Ceramic N750	750V	Selected on test	Erie N750-A
C2	.047uF	Plastic Film	30V	20	Mullard C280AA/P47K
C3	.047uF	Plastic Film	30V	20	Mullard C280AA/P47K
C4		Ceramic N750	750V	Selected on test	Erie N750-A
C5	3-30pF	Trimmer			Mullard E7876
C6	3-30pF	Trimmer			Mullard E7876
C7	3-30pF	Trimmer			Mullard E7876
C8	3-30pF	Trimmer			Mullard E7876
C9	3-30pF	Trimmer			Mullard E7876
C10	3-30pF	Trimmer			Mullard E7876
C11	3-30pF	Trimmer			Mullard E7876
C12	3-30pF	Trimmer			Mullard E7876
C13	0.1uF	Plastic Film	30V	20	Mullard C280AA/P100K
C14	0.1uF	Plastic Film	30V	20	Mullard C280AA/P100K
C15	0.1uF	Plastic Film	30V	20	Mullard C280AA/P100K

SWITCHES

SA	4 pole Channel Switch	Racal BSW33188
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Cct. Ref.	Value	Description	Rat.	Tol. %	N. A. T. O. No.	Manufacturer
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CHANNEL OSC. AND CRYSTAL OVEN (Continued)

TRANSISTORS

VT1		Germanium PNP				Philco 2N2360
VT2		Germanium PNP				Philco 2N2360
VT3		Silicon PNP				Brush OC700A
VT4		Silicon PNP				Brush OC700A
VT5		Silicon NPN				Texas 2S732
VT6		Germanium PNP				Mullard OC36

DIODES

MR1		Zener				Mullard OAZ245
MR2		Silicon				AEISJ104F

MISCELLANEOUS

		Crystal Holder Sockets				McMurdo X2/UG
		Woods Metal				
TH1		Thermistor				S. T. & C. M53
XL1-XL8		Frequency as required				Cathodeon Style D to Racal BD23443

I. F. UNIT

Note: All component references Prefixed 2

RESISTORS

5905-99-

R1	10K	Composition	0.1W	10	012-1680	Erie 15
R2	6.8K	Composition	0.1W	10	012-1674	Erie 15
R3	1.8K	Composition	0.1W	10	012-1653	Erie 15
R4	10K	Composition	0.1W	10	012-1680	Erie 15
R5	6.8K	Composition	0.1W	10	012-1674	Erie 15
R6	4.7K	Composition	0.1W	10	012-1668	Erie 15
R7	4.7K	Composition	0.1W	10	012-1668	Erie 15
R8	6.8K	Composition	0.1W	10	012-1674	Erie 15
R9	6.8K	Composition	0.1W	10	012-1674	Erie 15
R10	10K	Composition	0.1W	10	012-1680	Erie 15
R11	10K	Composition	0.1W	10	012-1680	Erie 15
R12	10K	Composition	0.1W	10	012-1680	Erie 15
R13	470	Composition	0.1W	10	012-1632	Erie 15
R14	33	Composition	0.1W	10		Erie 15
R15		Composition	0.1W	Selected on test		Erie 15
R16	1.8K	Composition	0.1W	10	012-1653	Erie 15
R17	100	Composition	0.1W	10	012-1608	Erie 15
R18	100	Composition	0.1W	10	012-1608	Erie 15
R19	470	Composition	0.1W	10	012-1632	Erie 15
R20	1K	Composition	0.1W	10	012-1644	Erie 15

Cct. Ref.	Value	Description	Rat.	Tol. %	N. A. T. O. No.	Manufacturer
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I. F. UNIT (Continued)

RESISTORS (Continued) 5905-99-

R21	1K	Composition	0.1W	10	012-1644	Erie 15
R22	4.7K	Composition	0.1W	10	012-1668	Erie 15
R23	10K	Composition	0.1W	10	012-1680	Erie 15
R24	10K	Composition	0.1W	10	012-1680	Erie 15
R25		Composition	0.1W	Selected on test		Erie 15
R26	10K	Composition	0.1W	10	012-1680	Erie 15
R27	470	Composition	0.1W	10	012-1632	Erie 15
R28	1K	Composition	0.1W	10	012-1644	Erie 15
R29	1K	Composition	0.1W	10	012-1644	Erie 15
R30	10K	Composition	0.1W	10	012-1680	Erie 15
R31	330	Composition	0.1W	10	012-1626	Erie 15
R32	2.2K	Composition	0.1W	10	012-1656	Erie 15
R33	100K	Composition	0.1W	10	012-1716	Erie 15
R34	2.2K	Composition	0.1W	10	012-1656	Erie 15
R35	10K	Composition	0.1W	10	012-1680	Erie 15
R36	6.8K	Composition	0.1W	10	012-1674	Erie 15
R37	220	Composition	0.1W	10	012-1620	Erie 15
R38	1K	Composition	0.1W	10	012-1644	Erie 15
R39	10K	Composition	0.1W	10	012-1668	Erie 15
R40	4.7K	Composition	0.1W	10	012-1680	Erie 15
R41	100K	Composition	0.1W	10	012-1716	Erie 15
R42	220K	Composition	0.1W	10	012-1732	Erie 15
R43	10K	Composition	0.1W	10	012-1680	Erie 15
R44	4.7K	Composition	0.1W	10	012-1668	Erie 15
R45	10K	Composition	0.1W	10	012-1680	Erie 15
R46	4.7K	Composition	0.1W	10	012-1668	Erie 15
R47	22K	Composition	0.1W	10	012-1692	Erie 15
R48	4.7K	Composition	0.1W	10	012-1668	Erie 15

POTENTIOMETERS

RV1	10K	Carbon				Painton 316 508
RV2	10K	Carbon				Painton 316 508
RV3	10K	Wirewound				Colvern CLR1106/15

CAPACITORS 5910-99-

C1	180pF	Polystyrene	125V	2		Salford PF
C2	180pF	Polystyrene	125V	2		Salford PF
C3	5.6pF	Ceramic Disc	500V	$\frac{1}{2}$ pF		Erie 831 Gimmicon
		N750				
C4	.047uF	Plastic Film	30V	20		Mullard C280AA/P47K
C5	.047uF	Plastic Film	30V	20		Mullard C280AA/P47K

Cct. Ref.	Value	Description	Rat.	Tol. %	N. A. T. O. No.	Manufacturer
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I. F. UNIT (Continued)

CAPACITORS (Continued) 5910-99-

C6	60pF	Trimmer				Mullard C010AA/60E
C7	.047uF	Plastic Film	30V	20		Mullard C280AA/P47K
C8	.047uF	Plastic Film	30V	20		Mullard C280AA/P47K
C9	.047uF	Plastic Film	30V	20		Mullard C280AA/P47K
C10	.047uF	Plastic Film	30V	20		Mullard C280AA/P47K
C11	.047uF	Plastic Film	30V	20		Mullard C280AA/P47K
C12	.001uF	Silver Mica	350V	2		S. T. & C. 454/LWA/51
C13	.047uF	Plastic Film	30V	20		Mullard C280AA/P47K
C14	.047uF	Plastic Film	30V	20		Mullard C280AA/P47K
C15	.047uF	Plastic Film	30V	20		Mullard C280AA/P47K
C16	220pF	Polystyrene	125V	2		Salford PF
C17	220pF	Polystyrene	125V	2		Salford PF
C18	220pF	Polystyrene	125V	2		Salford PF
C19	220pF	Polystyrene	125V	2		Salford PF
C20	220pF	Polystyrene	125V	2		Salford PF
C21	220pF	Polystyrene	125V	2		Salford PF
C22	0.1uF	Plastic Film	30V	20		Mullard C280AA/P100K
C23	0.1uF	Plastic Film	30V	20		Mullard C280AA/P100K
C24	0.1uF	Plastic Film	30V	20		Mullard C280AA/P100K
C25	220pF	Polystyrene	125V	2		Salford PF
C26		NOT USED				
C27	0.1uF	Plastic Film	30V	20		Mullard C280AA/P100K
C28	.047uF	Plastic Film	30V	20		Mullard C280AA/P47K
C29	0.1uF	Plastic Film	30V	20		Mullard C280AA/P100K
C30	220pF	Polystyrene	125V	2		Salford PF
C31	0.1uF	Plastic Film	30V	20		Mullard C280AA/P100K
C32	.001uF	Silver Mica	350V	2		S. T. & C. 454/LWA/51
C33	0.1uF	Plastic Film	30V	20		Mullard C280AA/P100K
C34	64uF	Electrolytic	25V			Mullard C426AM/F64
C35	64uF	Electrolytic	25V			Mullard C426AM/F64
C36	3.3pF	Ceramic Disc N750	500V	$\frac{1}{2}$ pF		Erie 831/Gimmicon
C37	10pF	Silver Mica	350V	1pF		S. T. & C. 454/LWA/51
C38		NOT USED				
C39		NOT USED				
C40		DELETED				
C41	0.1uF	Plastic Film	30V	20		Mullard C280AA/P100K
C42	47pF	Polystyrene	125V	2		Salford PF
C43	220pF	Polystyrene	125V	2		Salford PF
C44	11pF	Trimmer				Erie 3116Z
C45	220pF	Polystyrene	125V	2		Salford PF

Cct. Ref.	Value	Description	Rat.	Tol. %	N. A. T. O. No.	Manufacturer
<u>I. F. UNIT (Continued)</u>						
CAPACITORS (Continued) 5910-99-						
C46	220pF	Polystyrene	125V	2		Salford PF
C47	4.7pF	Ceramic NPO	750V	$\frac{1}{2}$ pF	011-9970	Erie NPO-A
C48	11pF	Trimmer				Erie 3116Z
C49	11pF	Trimmer				Erie 3116Z
C50	6.8pF	Ceramic NPO	750V	$\frac{1}{2}$ pF	011-9972	Erie NPO-A
C51	11pF	Trimmer				Erie 3116Z
C52	0.1uF	Plastic Film	30V	20		Mullard C280AA/P100K
C53	0.1uF	Plastic Film	30V	20		Mullard C280AA/P100K
C54	0.1uF	Plastic Film	30V	20		Mullard C280AA/P100K
C55	0.1uF	Metallised Film	250V	20		Wima MKS
C56	6.8pF	Ceramic NPO	750V	$\frac{1}{2}$ pF	011-9972	Erie NPO-A
INDUCTORS						
L1		700kc/s Coil Assy.				Racal BA25338
L2		3 Mc/s Coil Assy.				Racal BA25337
L3		Coil Assy. LSB Filter Input				Racal BA24539
L4		Coil Assy. USB Filter Input				Racal BA24540
L5		Coil Assy. AM Input				Racal BA24539
L6		Coil Assy. LSB Filter Output				Racal BA24542
L7		Coil Assy. USB Filter Output				Racal BA24541
L8		Coil Assy. AM Output				Racal BA24542
L9		Coil Assy. 3 Mc/s I. F.				Racal BA25165
L10		Coil Assy. 3 Mc/s I. F.				Racal BA25169
L11		L. F. Choke				Racal BT23832
L12		Coil Assy. L-C Filter				Racal BA24538
L13		Coil Assy. L-C Filter				Racal BA24544
L14		Coil Assy. L-C Filter				Racal BA24543
SWITCHES						
SA		4 pole, 5 posn. Rotary Wafers				Racal BSW21165
TRANSISTORS						
VT1		Germanium PNP				Philco 2N2360
VT2		Germanium PNP				Texas 2G402
VT3		Germanium PNP				Philco 2N2360
VT4		Germanium PNP				Texas 2G402
VT5		Germanium PNP				Texas 2G402
VT6		Germanium PNP				Texas 2G402
VT7		Silicon PNP				Brush OC702
VT8		Silicon NPN				Texas 2S732
VT9		Silicon NPN				S. T. & C. BSY27

Cct. Ref.	Value	Description	Rat. %	Tol.	N. A. T. O. No.	Manufacturer
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I. F. UNIT (Continued)

TRANSISTORS (Continued)

VT10		Silicon NPN				S. T. & C. BSY95
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DIODES

MR1		Germanium				Mullard OA95
MR2		Silicon				Mullard OA200
MR3		Silicon				Mullard OA200
MR4		Silicon				Mullard OA200
MR5		Silicon				Texas 1S132
MR6		Silicon				Texas 1S132
MR7		Silicon				Texas 1S132
MR8		Silicon				Mullard OA200

RELAYS

RLA/2		2CO				C. P. CLARE Type F
RLB/2		2CO				C. P. CLARE Type F
RLC/2		2CO				C. P. CLARE Type F

CRYSTALS

XL1		3.7 Mc/s Osc.				Cathodeon Style D to Racal BD23443
XL2		L-C Crystal Filter				Racal CD35974/A
XL3		L-C Crystal Filter				Racal CD35974/B
XL4		L-C Crystal Filter				Racal CD35974/A
XL5		L-C Crystal Filter				Racal CD35974/B
XL6		U. S. B. Filter				Racal CD35974/D
XL7		U. S. B. Filter				Racal CD35974/C
XL8		U. S. B. Filter				Racal CD35974/E
XL9		U. S. B. Filter				Racal CD35974/F
XL10		L. S. B. Filter				Racal CD35974/A
XL11		L. S. B. Filter				Racal CD35974/D
XL12		L. S. B. Filter				Racal CD35974/A
XL13		L. S. B. Filter				Racal CD35974/G

MISCELLANEOUS

		3.7 Mc/s Crystal Oscillator				Racal BA23943
		L-C Crystal Filter				Racal BA23121
		L. S. B. Filter				Racal BA23052
		U. S. B. Filter				Racal BA23071

Cct. Ref.	Value	Description	Rat.	Tol. %	N. A. T. O. No.	Manufacturer
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3 MC/S CARRIER RE-INSERTION OSCILLATOR (See page 6-22 for preset version)

Note: All component references Prefixed 5

RESISTORS

5905-99-

R1	4.7K	Carbon	0.1W	10	012-1668	Erie 15
R2	100K	Carbon	0.1W	10	012-1716	Erie 15
R3	100K	Carbon	0.1W	10	012-1716	Erie 15
R4	2.7K	Carbon	0.1W	10	012-1659	Erie 15
R5	3.9K	Carbon	0.1W	10	012-1665	Erie 15
R6	22	Carbon	0.1W	10		Erie 15

RESISTORS VARIABLE

RV1	5K	CLARIFIER control				Reliance W
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CAPACITORS

C1	820pF	Silver Mica	125V	1		S. T. & C. 454-LWA-61
C2	510pF	Silver Mica	125V	1		S. T. & C. 454-LWA-61
C3	100pF	Silver Mica	125V	2pF		S. T. & C. 454-LWA-60
C4	270pF	Silver Mica	125V	3pF		S. T. & C. 454-LWA-61
C5	47pF	Polystyrene	125V	2		Salford PF
C6	0.1uF	Ceramic Disc	25V			Erie 811-T-25
C7	0.1uF	Ceramic Disc	25V			Erie 811-T-25
C8	0.1uF	Ceramic Disc	25V			Erie 811-T-25

INDUCTORS

L1		Coil Assy.				Racal CT35492
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TRANSISTORS

VT1		Silicon NPN				S. T. & C. BFY19
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DIODES

D1		Variable Capacitance				Hughes HC7002
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CRYSTALS

XL1		3 Mc/s				Cathodeon Style D to Racal BD23444
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B. F. O.

Note: All component references Prefixed 8

RESISTORS

5905-99-

R1	47	Composition	0.1W	10		Erie 15
R2	47	Composition	0.1W	10		Erie 15
R3	12K	Composition	0.1W	10	012-1683	Erie 15

Cct. Ref.	Value	Description	Rat.	Tol. %	N. A. T. O. No.	Manufacturer
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B. F. O. (Continued)

RESISTORS (Continued)

5905-99-

R4	100K	Composition	0.1W	10	012-1716	Erie 15
R5	56	Composition	0.1W	10		Erie 15
R6	15K	Composition	0.1W	10	012-1686	Erie 15
R7	3.3K	Composition	0.1W	10	012-1662	Erie 15
R8	22K	Composition	0.1W	10	012-1692	Erie 15

POTENTIOMETER

10K	Linear Wirewound	Colvern CLR1106/12
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CAPACITORS

5910-99-

C1	.01uF	Plastic Film	30V	20		Mullard C280AA/P10K
C2	100pF	Silver Mica	350V	2		S. T. & C. 454/LWA/51
C3	20pF	Ceramic N750	750V	5	011-8609	Erie N750-B
C4	.047uF	Plastic Film	30V	20		Mullard C280AA/P47K
C5	.047uF	Plastic Film	30V	20		Mullard C280AA/P47K
C6	18pF	Polystyrene	125V	1		Salford PF
C7	.01uF	Plastic Film	30V	20		Mullard C280AA/P10K
C8	47pF	Polystyrene	125V	2		Salford PF
C9	180pF	Silver Mica	350V	2		S. T. & C. 454/LWA/51

INDUCTORS

L1	B. F. O. Coil Assy.	Racal BA25579
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TRANSISTOR

VT1	Germanium PNP	Philco 2N2360
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DIODE

MR1	Variable Capacity	Brush BA110
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A. F. UNIT

Note: All component references Prefixed 4

RESISTORS

5905-99-

R1	330K	Composition	0.1W	10	012-1738	Erie 15
R2	330K	Composition	0.1W	10	012-1738	Erie 15
R3	56K	Composition	0.1W	10	012-1707	Erie 15
R4	330K	Composition	0.1W	10	012-1738	Erie 15
R5	330K	Composition	0.1W	10	012-1738	Erie 15
R6		NOT USED				
R7	1K	Composition	0.1W	10	012-1644	Erie 15
R8	10K	Composition	0.1W	10	012-1680	Erie 15
R9		NOT USED				

Cct. Ref.	Value	Description	Rat.	Tol. %	N. A. T. O. No.	Manufacturer
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A. F. UNIT (Continued)

RESISTORS (Continued) 5905-99-

R10	2.7K	Composition	0.1W	10	012-1659	Erie 15
R11	15K	Composition	0.1W	10	012-1686	Erie 15
R12	4.7K	Composition	0.1W	10	012-1668	Erie 15
R13	150	Composition	0.1W	10	012-1614	Erie 15
R14	1.8K	Composition	0.1W	10	012-1653	Erie 15
R15	10K	Composition	0.1W	10	012-1680	Erie 15
R16	33K	Composition	0.1W	10	012-1698	Erie 15
R17	1K	Composition	0.1W	10	012-1644	Erie 15
R18	6.8K	Composition	0.1W	10	012-1674	Erie 15
R19	470	Composition	0.1W	10	012-1632	Erie 15
R20	1K	Composition	0.1W	10	012-1644	Erie 15
R21	3.3K	Composition	0.1W	10	012-1662	Erie 15
R22	100	Composition	0.1W	10	012-1608	Erie 15
R23	100	Composition	0.1W	10	012-1608	Erie 15
R24	22K	Composition	0.1W	10	012-1692	Erie 15
R25	33	Composition	0.1W	10		Erie 15
R26	33	Composition	0.1W	10		Erie 15
R27	2.2	Wirewound	1.5W	10	011-3199	Welwyn AW3101
R28	2.2	Wirewound	1.5W	10	011-3199	Welwyn AW3101
R29	270	Composition	0.1W	10	012-1623	Erie 15
R30	15	Wirewound	1.5W	5	011-3211	Welwyn AW3101

POTENTIOMETERS

RV1	500K	Miniature pre-set				Plessey Type G Mk. 5
RV2	1K	Miniature pre-set				Plessey Type G Mk. 5
RV3	2.5K	A. F. GAIN Control				Morganite L. H.
RV4	100	Miniature pre-set				Plessey MP Dealer

CAPACITORS 5910-99-

C1	220pF	Polystyrene	125V	2		Salford PF
C2	0.1uF	Metallised Film	250V	20		Wima MKS
C3	.047uF	Polyester	200V	20		TCC. PMX3
C4	.047uF	Polyester	200V	20		TCC. PMX3
C5	18pF	Polystyrene	125V	2		Salford PF
C6	120pF	Polystyrene	125V	2		Salford PF
C7	25uF	Electrolytic	25V			Mullard C426AM/F25
C8	25uF	Electrolytic	25V			Mullard C426AM/F25
C9	.0033uF	Hi-K Ceramic	350V	20		LEMCO 316K
C10	25uF	Electrolytic	25V			Mullard C426AM/F25
C11	25uF	Electrolytic	25V			Mullard C426AM/F25
C12	25uF	Electrolytic	25V			Mullard C426AM/F25

Cct. Ref.	Value	Description	Rat.	Tol. %	N. A. T. O. No.	Manufacturer
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A. F. UNIT (Continued)

CAPACITORS (Continued) 5910-99-

C13	820pF	Hi-K Ceramic	350V	20		LEMCO 310K
C14	0.1uF	Polyester	200V	20		TCC PMX4
C15	.01uF	Polyester	200V	20		TCC PMX1
C16	330pF	Ceramic N750	750V	2	011-8638	Erie N750-C
C17	25uF	Electrolytic	25V			Mullard C426AM/F25
C18	25uF	Electrolytic	25V			Mullard C426AM/F25
C19	.001uF	Hi-K Ceramic	350V	20		LEMCO 310K
C20	25uF	Electrolytic	25V			Mullard C426AM/F25
C21	64uF	Electrolytic	25V			Mullard C426AM/F64
C22	64uF	Electrolytic	25V			Mullard C426AM/F64
C23	.047uF	Polyester	200V	20		TCC PMX3
C24	64uF	Electrolytic	25V			Mullard C426AM/F64
C25	64uF	Electrolytic	25V			Mullard C426AM/F64
C26	0.1uF	Polyester	200V	20		TCC PMX4
C27	25uF	Electrolytic	25V			Mullard C426AM/F25
C28	100uF	Electrolytic	16V			Mullard C426AM/E100
C29	100uF	Electrolytic	16V			Mullard C426AM/E100
C30	25uF	Electrolytic	25V			Mullard C426AM/F25
C31	25uF	Electrolytic	25V			Mullard C426AM/F25
C32	1pF	Ceramic P100	750V	1/2pF	011-8338	Erie P100-A
C33	0.1uF	Metallised Film	250V	20		Wima MKS
C34		DELETED				
C35	200uF	Electrolytic	10V			Mullard C426AR/D200
C36	200uF	Electrolytic	10V			Mullard C426AR/D200

INDUCTORS

L1	Coil Assy.	Racal BA26153
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TRANSFORMERS

T1	Telephone Line Output	Racal BT23827
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SWITCHES 5930-99-

SA	Speaker, co., toggle	051-0504 NSF. 8373/B102
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TRANSISTORS

VT1	Silicon NPN	Fairchild C444
VT2	Germanium PNP	Mullard ACY21
VT3	Silicon PNP	Texas 2S324
VT4	Silicon PNP	Texas 2S324
VT5	Silicon PNP	Mullard OC206
VT6	Silicon NPN	Mullard 2N2297

Cct. Ref.	Value	Description	Rat.	Tol. %	N. A. T. O. No.	Manufacturer
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A. F. UNIT (Continued)

TRANSISTORS (Continued)

VT7		Silicon NPN				Texas 2S732
VT8		Silicon NPN				Mullard 2N2297

DIODES

MR1		Silicon				Mullard OA200
MR2		Silicon				Mullard OA200

RELAYS

RLA/2						CP. CLARE Type F
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MISCELLANEOUS

JK1		Jack				Igranic Type P73
LS1		2½", 15Ω Speaker				ELAC Type 2ST

SQUELCH UNIT

Note: All component references Prefixed 7

RESISTORS

5905-99-

R1	15	Wirewound	1.5W	5	011-3211	Welwyn AW3101
R2	10K	Metal Oxide	¼W	5	012-8691	Electrosil TR4
R3	180	Metal Oxide	¼W	5	012-8649	Electrosil TR4
R4	3.3K	Metal Oxide	¼W	5	012-8679	Electrosil TR4
R5	6.8K	Metal Oxide	¼W	5	012-8687	Electrosil TR4
R5a	39K	Metal Oxide	¼W	2		Electrosil TR4
R6	4.7K	Metal Oxide	¼W	5	012-8683	Electrosil TR4
R6a	18K	Metal Oxide	¼W	2		Electrosil TR4
R7	470	Metal Oxide	¼W	5	012-8659	Electrosil TR4
R8	3.9K	Metal Oxide	¼W	5	012-8681	Electrosil TR4
R9	6.8K	Metal Oxide	¼W	5	012-8687	Electrosil TR4
R10	1.2K	Composition	½W	10	022-2018	Erie 8
R11	220	Metal Oxide	¼W	5	012-8651	Electrosil TR4
R12	100	Composition	0.1W	10	012-1608	Erie 15

POTENTIOMETER

RV1	5K	Pre-set				ANC.Dev.Co. ADW. 01
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CAPACITORS

C1	25uF	Electrolytic	25V			Mullard C426AM/F25
C2	25uF	Electrolytic	25V			Mullard C426AM/F25
C3	64uF	Electrolytic	25V			Mullard C426AM/F64
C4	0.1uF	Plastic Film	30V	20		Mullard C280AA/P100K

Cct. Ref.	Value	Description	Rat.	Tol. %	N. A. T. O. No.	Manufacturer
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SQUELCH UNIT (Continued)

TRANSISTORS

VT1		Silicon PNP				Texas 2S324
VT2		Germanium PNP				Mullard OC83
VT3		Germanium PNP				Mullard OC83

DIODE

MR1		Silicon junction				Mullard OA200
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RELAY

RLA/1		2 pole CO				Fortiphone G100
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A. C. POWERED UNIT

Note: All component references Prefixed 6

RESISTORS

5905-99-

R1	1.2K	Wirewound	1.5W	5	011-3257	Welwyn AW3101
R2	680	Wirewound	1.5W	5	011-3251	Welwyn AW3101
R3	2.2K	Wirewound	1.5W	5	011-3263	Welwyn AW3101
R4	1.2K	Wirewound	1.5W	5	011-3257	Welwyn AW3101
R5	10K	Wirewound	3W	5	011-3344	Welwyn V1
R6		NOT USED				
R7	120	Composition	$\frac{1}{4}$ W	10	022-1121	Erie 16

POTENTIOMETERS

RV1	1K	Pre-set				Colvern CLR1106/95
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CAPACITORS

5910-99-

C1		DELETED				
C2		DELETED				
C3	64uF	Electrolytic	25V			Mullard C426AM/F64
C4a	500uF	Electrolytic	50V			Mullard C431BR/H500
C4b	500uF	Electrolytic	50V			Mullard C431BR/H500
C4c	500uF	Electrolytic	50V			Mullard C431BR/H500
C5	2uF	Electrolytic				TCC.431FC
C6	2uF	Electrolytic				TCC.431FC
C7	0.1uF	Paper	350V	20	011-5506	TCC.CP45N
C8	0.1uF	Paper	350V	20	011-5506	TCC.CP45N
C9	0.1uF	Met. Film	250V	20		Wima MKS

TRANSFORMER

T1		Power				Racal BT21004
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Cct. Ref.	Value	Description	Rat.	Tol. %	N. A. T. O. No.	Manufacturer
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A. C. POWERED UNIT (Continued)

		SWITCH			5930-99-	
SA		2 pole, CO., Toggle			051-0504	NSF. 8373/B102

TRANSISTORS

VT1		Germanium PNP				Mullard OC36
VT2		Germanium PNP				Mullard ACY17
VT3		Germanium PNP				Mullard ACY17

RECTIFIERS AND DIODES

MR1		Silicon Rectifier				AEI SJ104F
MR2		Silicon Rectifier				AEI SJ104F
MR3		Silicon Rectifier				AEI SJ104F
MR4		Silicon Rectifier				AEI SJ104F
MR5		Silicon Rectifier				AEI SJ104F
MR6		Silicon Rectifier				AEI SJ104F
MR7		Silicon Rectifier				AEI SJ104F
MR8		Zener Diode		5		Brush ZB12
MR9		Zener Diode				AEI VR7F
MR10		Silicon Diode				Mullard OA200

FUSES

FS1		Cartridge Holder	1A			Belling-Lee L1055
FS2		Cartridge Holder	1A			Belling-Lee L510

24V D. C. POWERED UNIT

Note: All component references Prefixed 12

RESISTORS

R1	1.2K	Wirewound	1.5W	5	011-3257	Welwyn AW3101
R2	680	Wirewound	1.5W	5	011-3251	Welwyn AW3101
R3	2.2K	Wirewound	1.5W	5	011-3263	Welwyn AW3101
R4	1.2K	Wirewound	1.5W	5	011-3257	Welwyn AW3101
R5	10K	Wirewound	3W	5	011-3344	Welwyn V1

POTENTIOMETER

RV1	1K	Pre-set				Colvern CLR1106/95
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CAPACITORS

C1		DELETED
C2		DELETED

Cct. Ref.	Value	Description	Rat.	Tol. %	N. A. T. O. No.	Manufacturer
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24V D. C. POWERED UNIT (Continued)

CAPACITORS (Continued)

C3	64uF	Electrolytic	25V			Mullard C426AM/F64
C4	500uF	Electrolytic	50V			Mullard C431BR/H500
C5	500uF	Electrolytic	50V			Mullard C431BR/H500
C6	500uF	Electrolytic	50V			Mullard C431BR/H500
C7	0.1uF	Met. Film	250V	20		Wima MKS

SWITCH

5930-99-

SA	2 pole, CO., toggle	051-0504	NSF8373/B102
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TRANSISTORS

VT1	Germanium PNP	Mullard OC36
VT2	Germanium PNP	Mullard ACY17
VT3	Germanium PNP	Mullard ACY17

DIODES

MR1	Silicon	Mullard OA200
MR2	Zener	Brush ZB12
MR3	Silicon	AEI SJ104F
MR4	Silicon	AEI SJ104F
MR5	Zener	AEI VR7F
MR6	Silicon	AEI SJ104F

FUSES

FS1	Cartridge Holder	1A	Belling-Lee L1055
FS2	Cartridge Holder	1A	Belling-Lee L510

MISCELLANEOUS

Filter Unit

Racal CA27142

FILTER UNIT

Note: All component references Prefixed 10

CAPACITORS

C1	500uF	Electrolytic	50V		TCC CE26D
C2	1.0uF	Polystyrene	125V	5	Wima Tropyfol M
C3	1.0uF	Polystyrene	125V	5	Wima Tropyfol M
C4	500uF	Electrolytic	50V		TCC CE26D

INDUCTORS

L1	Choke	Racal AA27136
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Cct. Ref.	Value	Description	Rat.	Tol. %	N. A. T. O. No.	Manufacturer
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FILTER UNIT (Continued)

FUSES

FS1		Cartridge	2.5A			Belling-Lee L562
FS2		Cartridge	2.5A			Belling-Lee L562

12V D. C. POWERED UNIT

Note: All component references Prefixed 13

RESISTORS

5905-99-

R1	1.2K	Wirewound	1.5W	5	011-3257	Welwyn AW3101
R2	680	Wirewound	1.5W	5	011-3251	Welwyn AW3101
R3	2.2K	Wirewound	1.5W	5	011-3263	Welwyn AW3101
R4	1.2K	Wirewound	1.5W	5	011-3257	Welwyn AW3101
R5	10K	Wirewound	3W	5	011-3344	Welwyn V1

POTENTIOMETER

RV1	1K	Pre-set				Colvern CLR1106/95
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CAPACITORS

C1		DELETED				
C2		DELETED				
C3	64uF	Electrolytic	25V			Mullard C426AM/F64
C4	500uF	Electrolytic	50V			Mullard C431BR/H500
C5	500uF	Electrolytic	50V			Mullard C431BR/H500
C6	500uF	Electrolytic	50V			Mullard C431BR/H500
C7	0.1uF	Met Film	250	20		Wima MKS

SWITCH

5930-99-

SA		2 pole, CO., toggle			051-0504	NSF8373/B102
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TRANSISTORS

VT1		Germanium PNP				Mullard OC36
VT2		Germanium PNP				Mullard ACY17
VT3		Germanium PNP				Mullard ACY17

RECTIFIERS AND DIODES

MR1		Silicon Diode				Mullard OA200
MR2		Zener Diode		5		Brush ZB12
MR3		Silicon Rectifier				AEI SJ104F
MR4		Silicon Rectifier				AEI SJ104F
MR5		Zener Diode				AEI VR7F
MR6		Silicon Rectifier				AEI SJ104F
MR7		Silicon Rectifier				AEI SJ104F

Cct. Ref.	Value	Description	Rat.	Tol. %	N. A. T. O. No.	Manufacturer
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12V D. C. POWERED UNIT (Continued)

RECTIFIERS AND DIODES (Continued)

MR8		Silicon Rectifier				AEI SJ104F
MR9		Silicon Rectifier				AEI SJ104F
MR10		Silicon Rectifier				AEI SJ104F

FUSES

FS1		Cartridge Holder	1A			Belling-Lee L1055 Belling-Lee L510
FS2		Cartridge Holder	1A			Belling-Lee L1055 Belling-Lee L510

MISCELLANEOUS

		Invertor				Racal BA27146
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INVERTOR

Note: All component references Prefixed 11

RESISTORS 5905-99-

R1	15	Wirewound	3W	5	011-3276	Welwyn V1
R2	1K	Composition	$\frac{1}{2}$ W	10	022-2006	Erie 8

CAPACITORS

C1	500uF	Electrolytic	25V			TCC. CE90C
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TRANSFORMER

T1						Racal BT27148
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TRANSISTORS

VT1		Germanium PNP				Mullard OC36
VT2		Germanium PNP				Mullard OC36

FUSES

FS1		Cartridge Holder	2.5A			Belling-Lee L562 Belling-Lee L575
FS2		Cartridge Holder	2.5A			Belling-Lee L562 Belling-Lee L575

EXTENDED CONTROL MODULE MA. 346

Note: All component references Prefixed 9

SWITCHES 5930-99-

SA		Rotary, 2 pole 9 posn.				Racal BSW26045
SB		Toggle, 2 pole C. O.			051-0504	Arrow 81-058BT33

Cct. Ref.	Value	Description	Rat.	Tol. %	N. A. T. O. No.	Manufacturer
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EXTENDED CONTROL MODULE MA. 346 (Continued)

RECTIFIERS

MR1		Silicon Junction				AEI SJ104F
MR2		Silicon Junction				AEI SJ104F

SOCKETS

SKT1		15 pole fixed				McMurdo DA-15S
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RELAYS

<u>RLA</u> 2		675 Ω coil 2 C. O.				C. P. CLARE RP7632
<u>RLB</u> 2		675 Ω coil 2 C. O.				C. P. CLARE RP7632

MISCELLANEOUS

X1		Motor 28V D. C.				Pullin Type 11PM part No. 11/161
X2		Clutch 28V D. C.				Westool SF160 part No. 670416W

PRE-SET CARRIER RE-INSERTION OSC. (This sub-unit is not suitable for extended control)

Note: All component references prefixed 5

RESISTORS

					5905-99-	
R1	10K	Composition	0.1W	10	012-1680	Erie 15
R2	6.8K	Composition	0.1W	10	012-1674	Erie 15
R3	6.8K	Composition	0.1W	10	012-1674	Erie 15
R4	4.7K	Composition	0.1W	10	012-1668	Erie 15
R5						
R6						
R7	4.7K	Composition	0.1W	10	012-1668	Erie 15
R8	6.8K	Composition	0.1W	10	012-1674	Erie 15
R9	6.8K	Composition	0.1W	10	012-1674	Erie 15
R10	10K	Composition	0.1W	10	012-1680	Erie 15
R11	100	Composition	0.1W	10	012-1608	Erie 15
R12	100	Composition	0.1W	10	012-1608	Erie 15

CAPACITORS

					5910-99-	
C1	5.6pF	Ceramic	750V	$\frac{1}{2}$ pF	011-8599	Erie N750-A
C2	.047uF	Plastic Film	30V	20		Mullard C280AA/P47K
C3	47pF	Polystyrene	125V	2		Salford PF
C4	60pF	Trimmer				Mullard CO10AA60E
C5	.047uF	Plastic Film	30V	20		Mullard C280AA/P47K

Cct. Ref.	Value	Description	Rat.	Tol. %	N. A. T. O. No.	Manufacturer
C6	.047uF	Plastic Film	30V	20		Mullard C280AA/P47K
C7	.047uF	Plastic Film	30V	20		Mullard C280AA/P47K
C8		Ceramic	750V	Selected on test		Erie N750-A
C9	27pF	Polystyrene	125V	2		Salford PF
C10		Polystyrene	125V	Selected on test		Salford PF
C11	0.1uF	Plastic Film	30V	20		Mullard C280AA/P100K
C12	0.1uF	Plastic Film	30V	20		Mullard C280AA/P100K

TRANSISTORS

VT1	Philco 2N2360
VT2	Philco 2N2360

CRYSTALS

XL1	3 Mc/s	Cathodeon Style D to Racal BD23444
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ADDENDUM

The following components have been added:-

Cct. Ref.	Value	Description	Rat.	Tol.	N. A. T. O. No.	Manufacturer
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R. F. UNIT

RESISTORS

1R22	33k	carbon	0.1W	10	5905-99-012-1698	Erie 15
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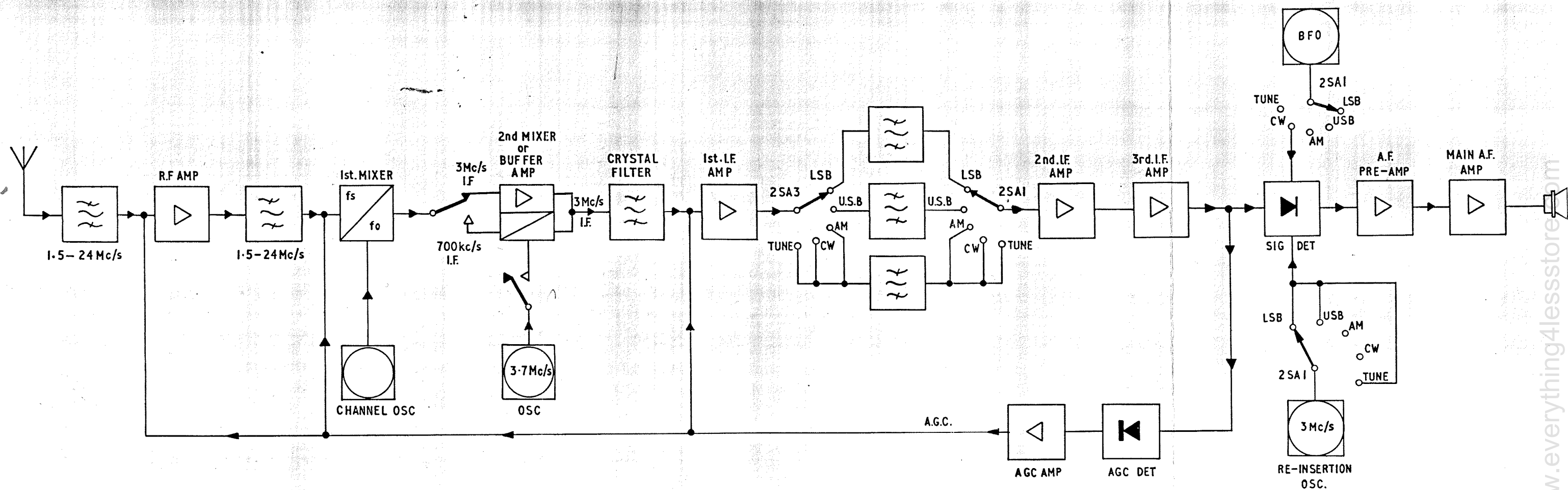
CAPACITORS

1C33	0.1 μ F	plastic film	30V	20		Mullard C280AA/ P100K
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I. F. UNIT

RESISTORS

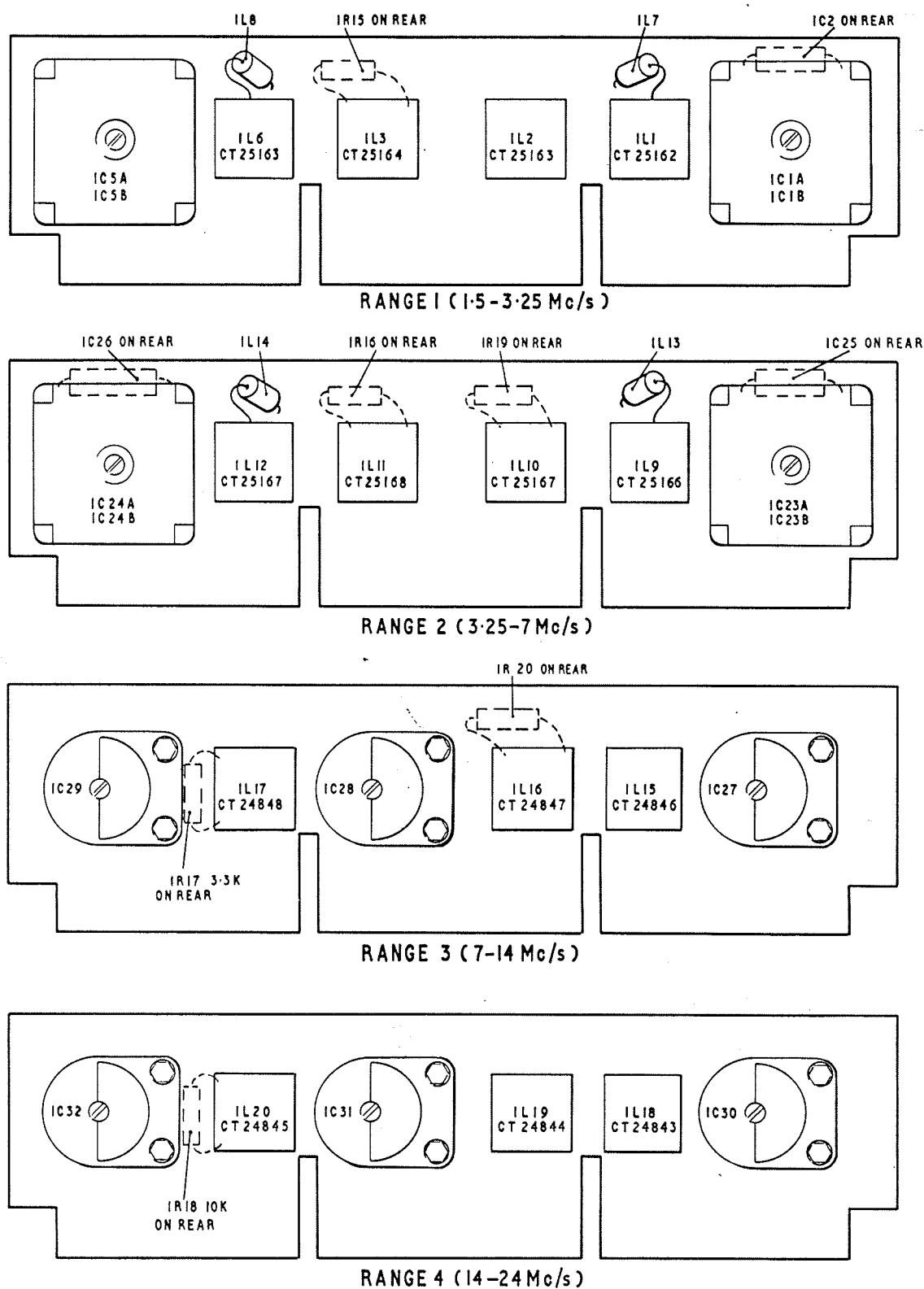
2R49	560	carbon	0.1W	10	5905-99-012-1635	Erie 15
------	-----	--------	------	----	------------------	---------

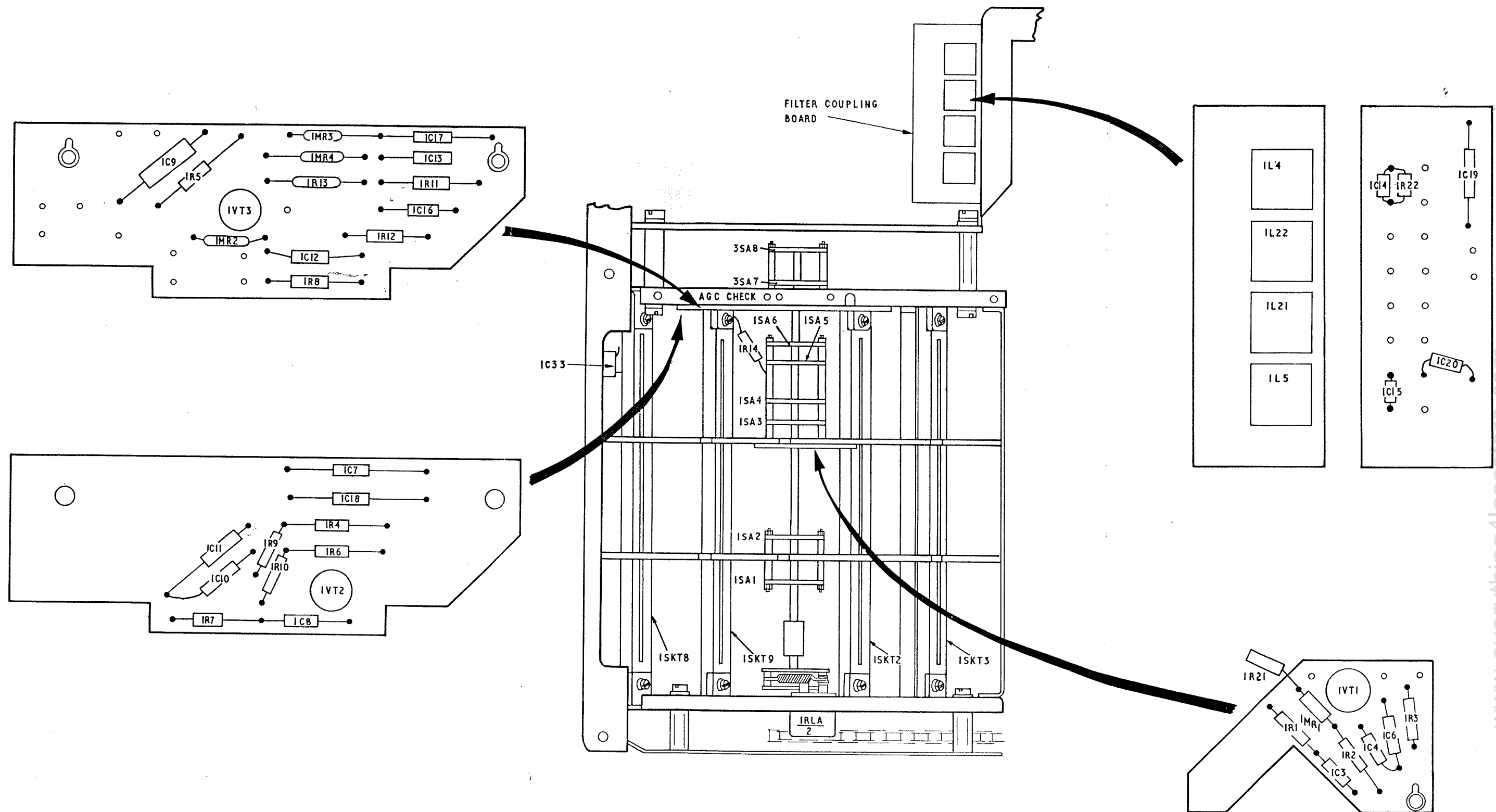


Block Diagram RA. 222

Fig. I

157/1

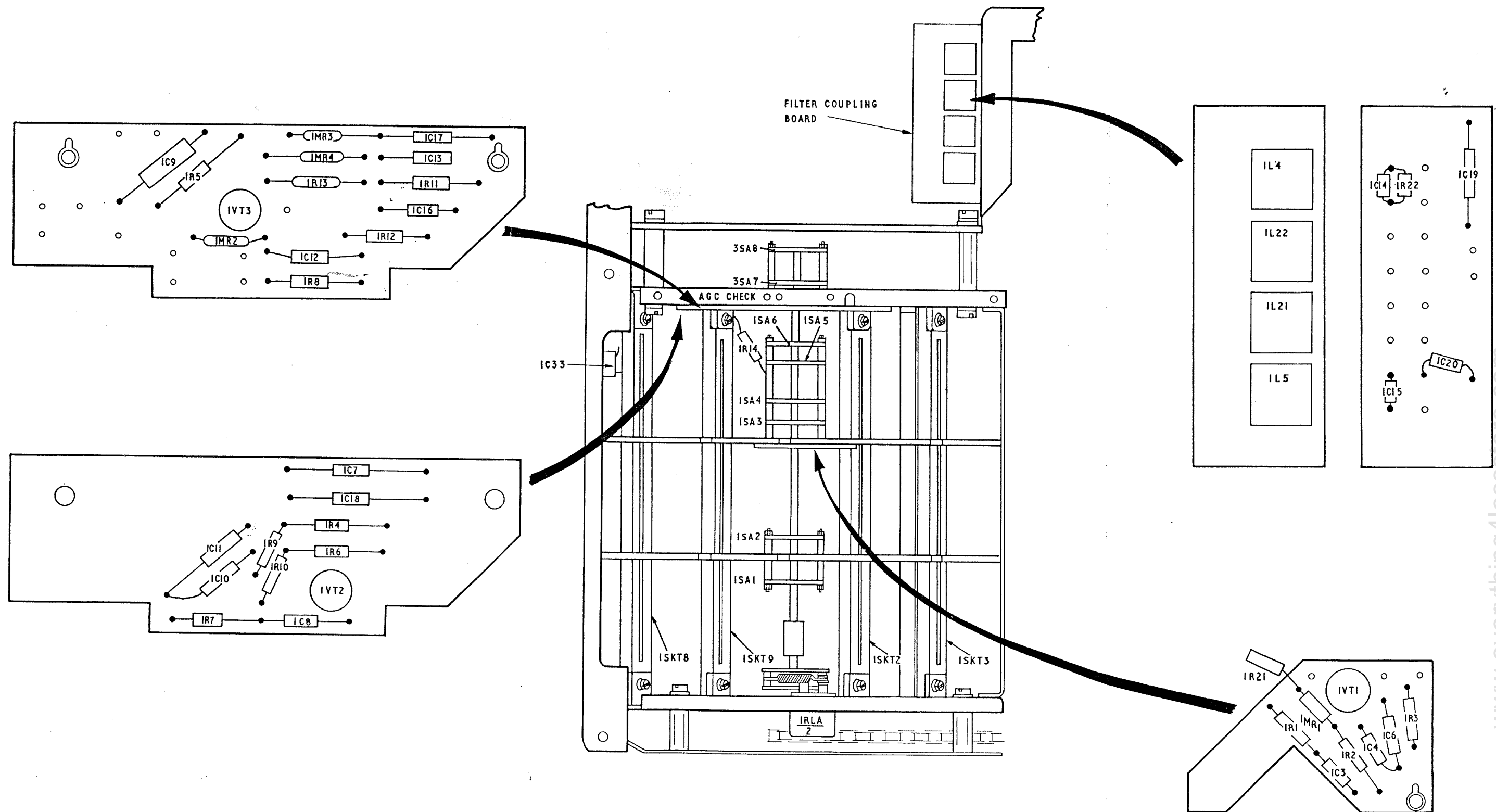




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Component Layout: R.F Unit

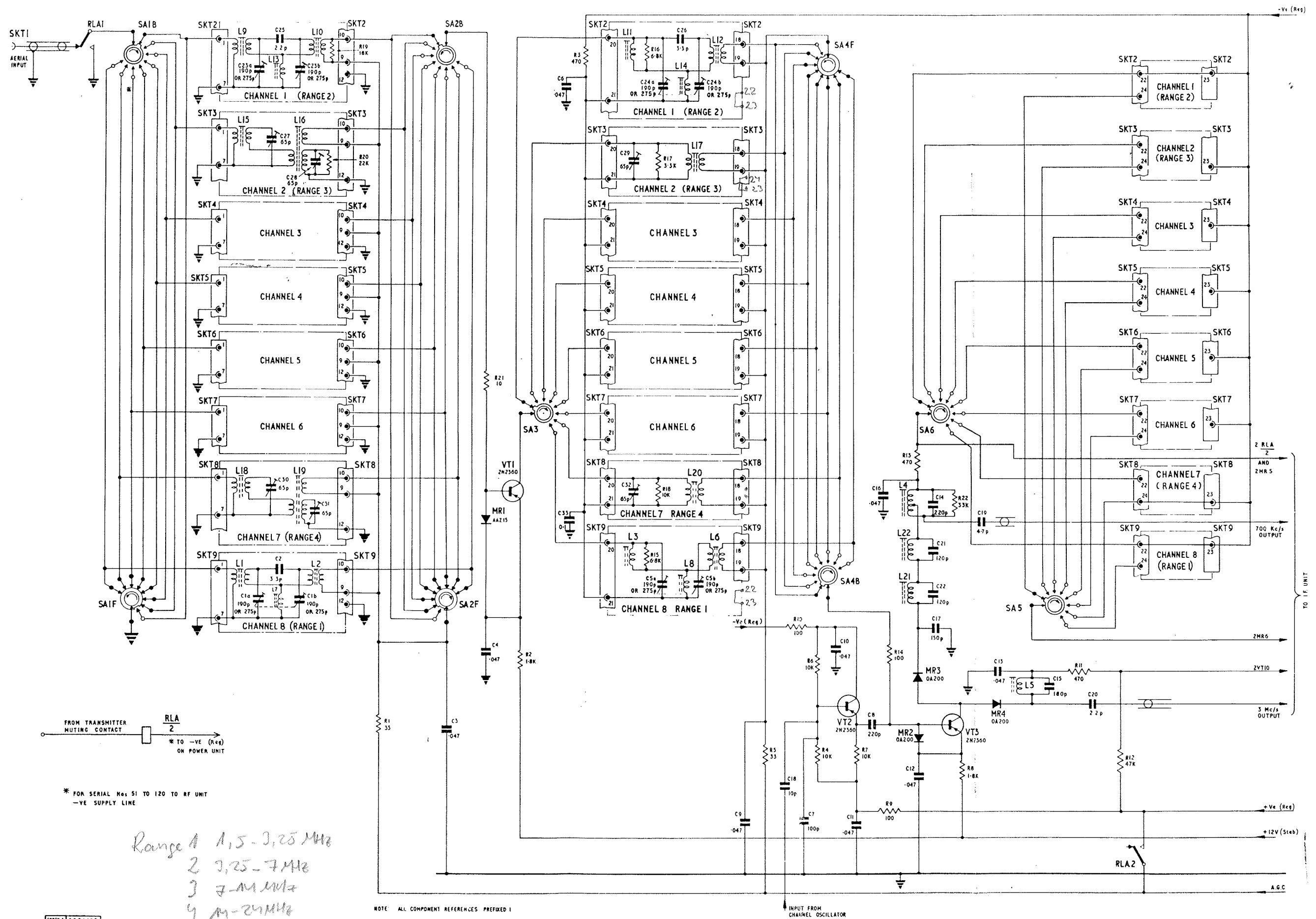
Fig.3



157/B3

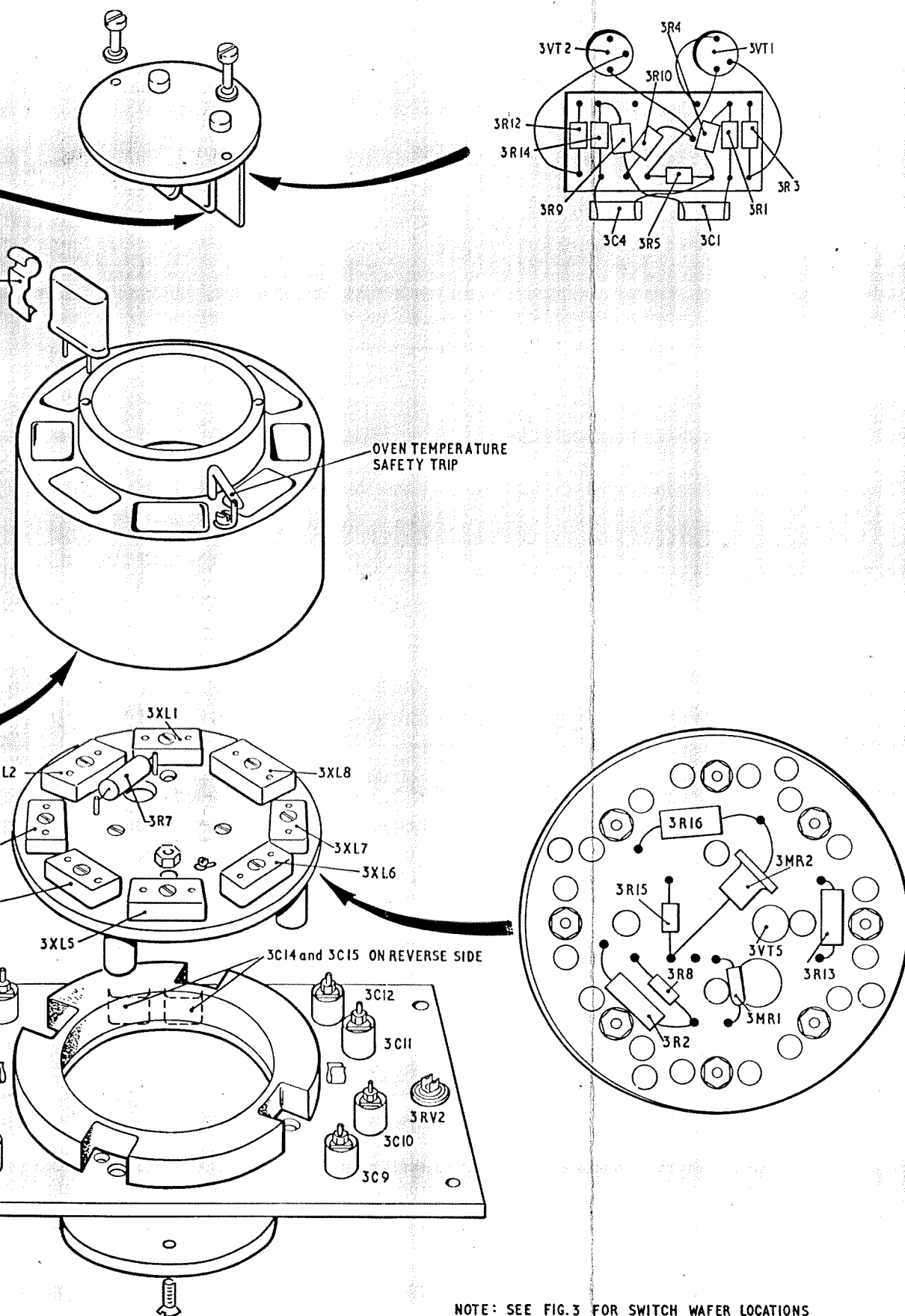
Component Layout: R.F. Unit

Fig.3



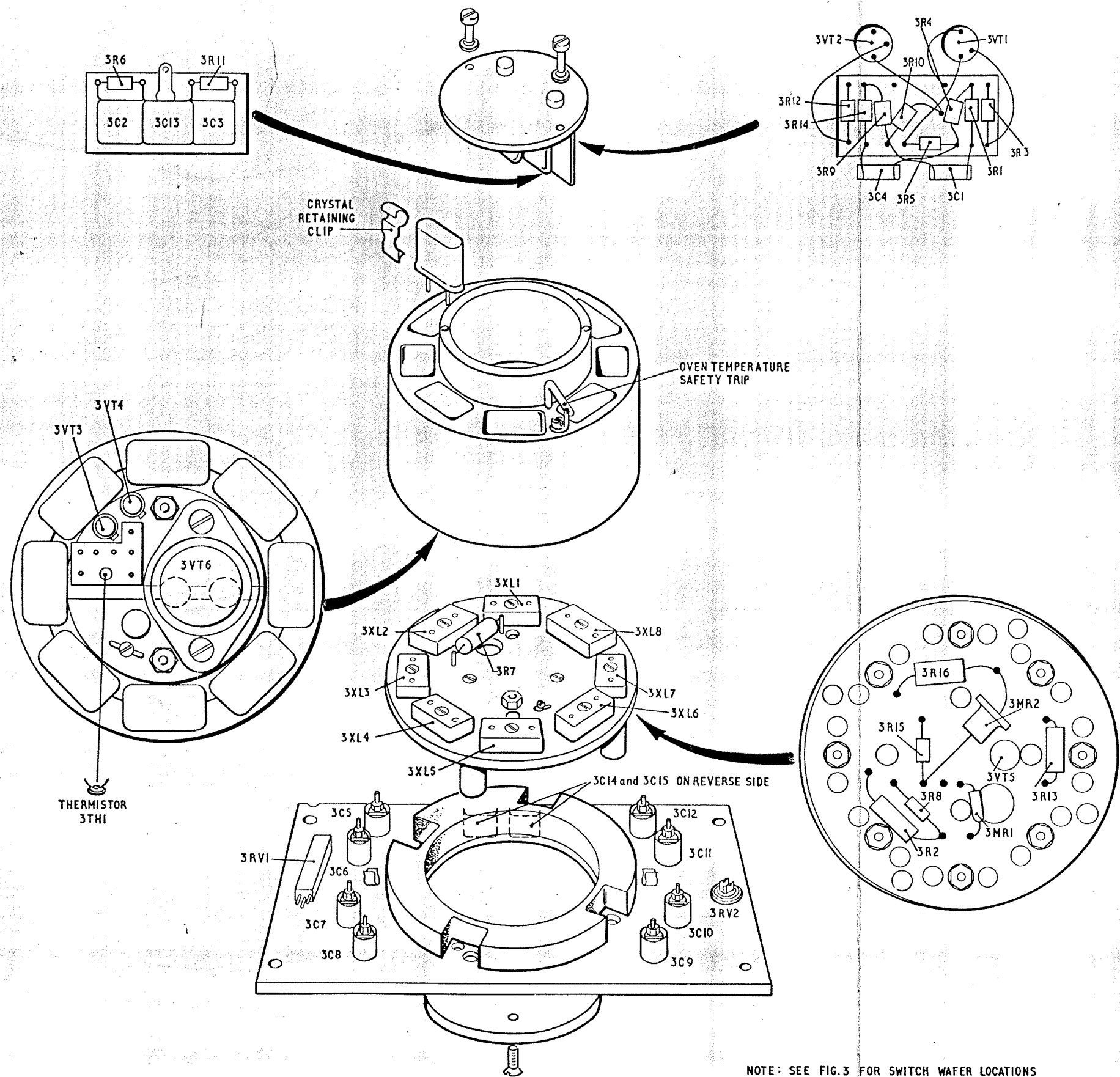
Circuit: R.F. Unit - RA.222

Fig.4



nt Layout: Channel Oscillator and Crystal Oven

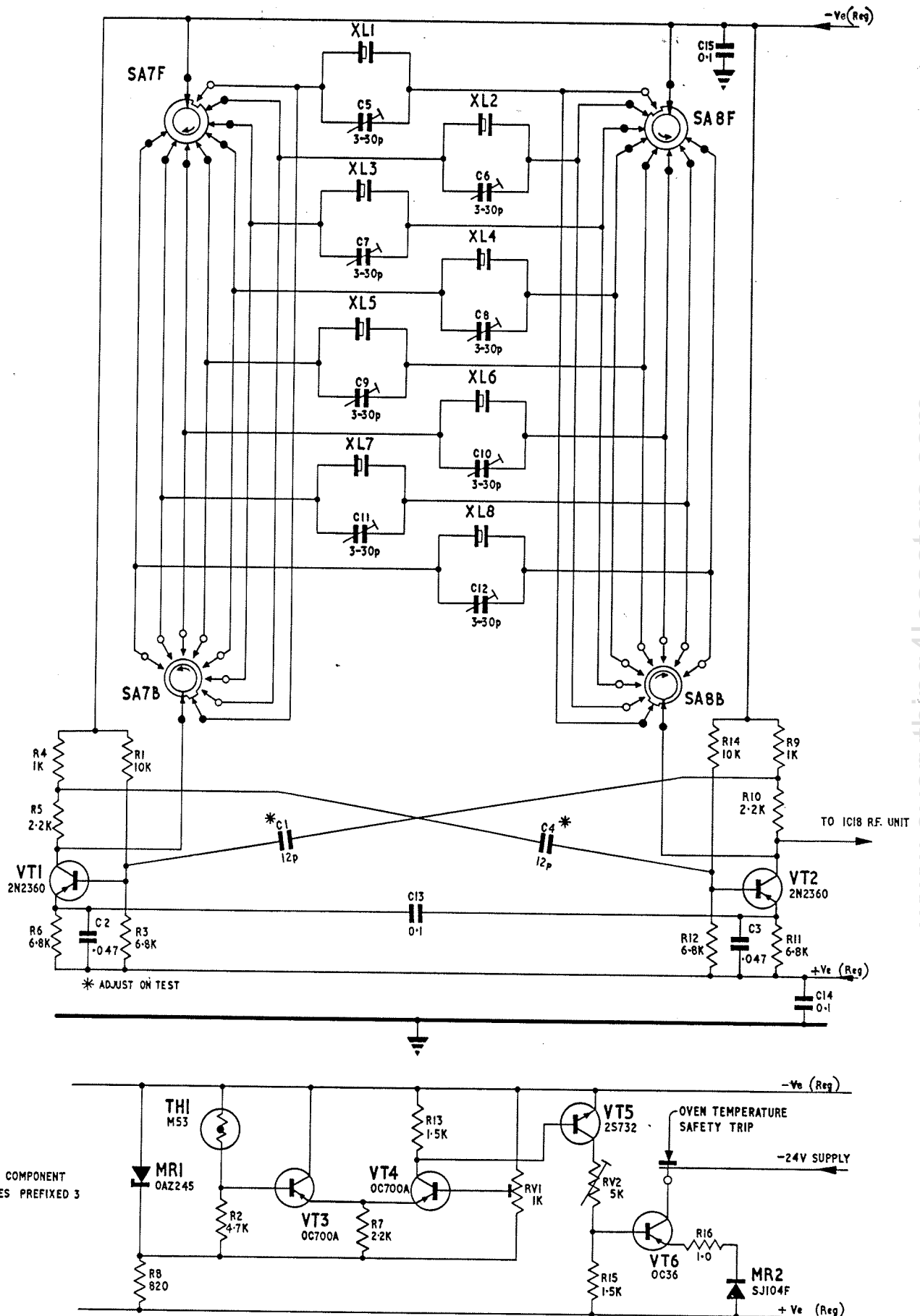
Fig.5



NOTE: SEE FIG.3 FOR SWITCH WAFER LOCATIONS

Component Layout: Channel Oscillator and Crystal Oven

Fig.5



157/B6/CC23619

Circuit: Channel Oscillator and Crystal Oven - RA.222

Fig.6

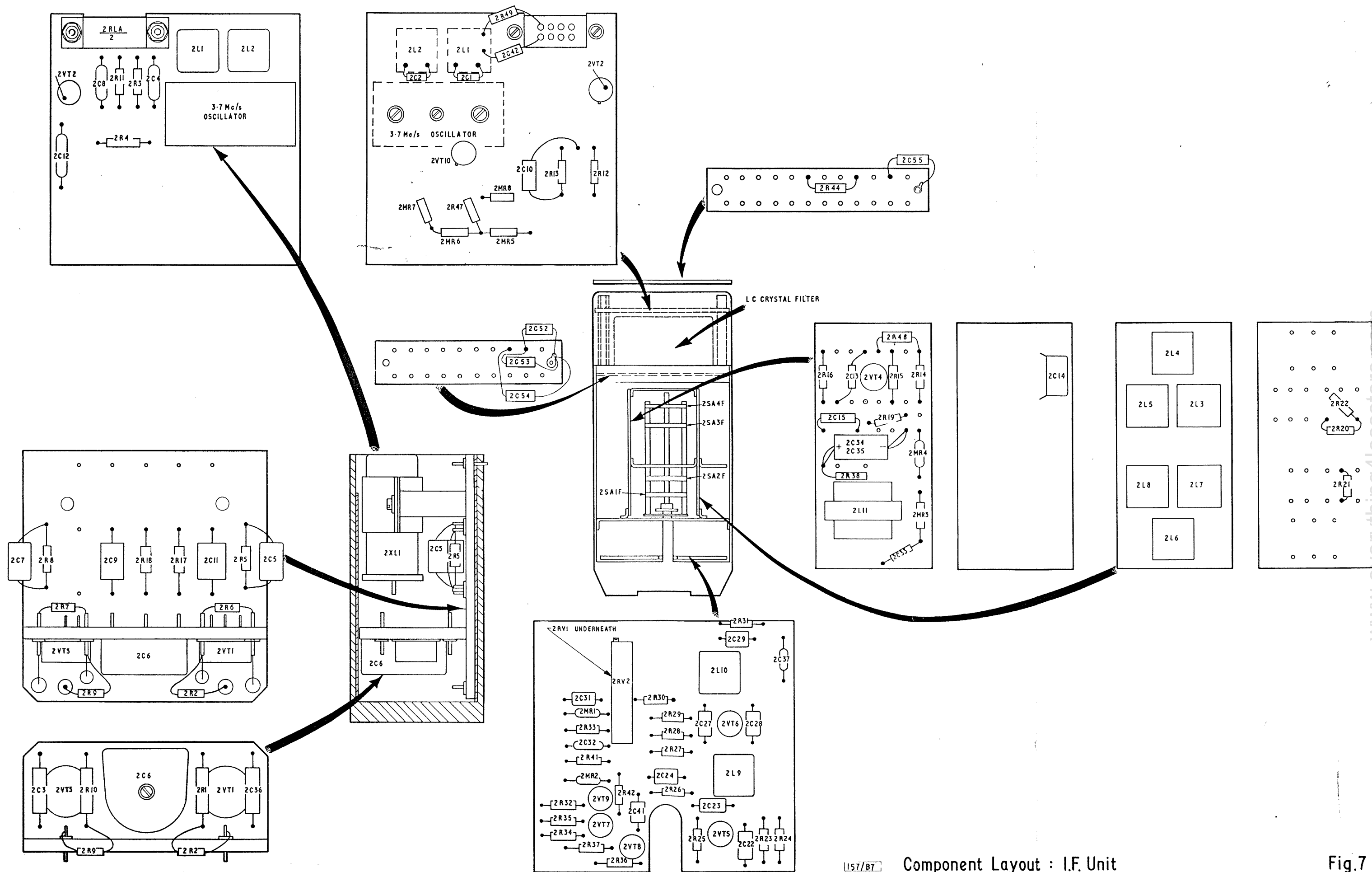
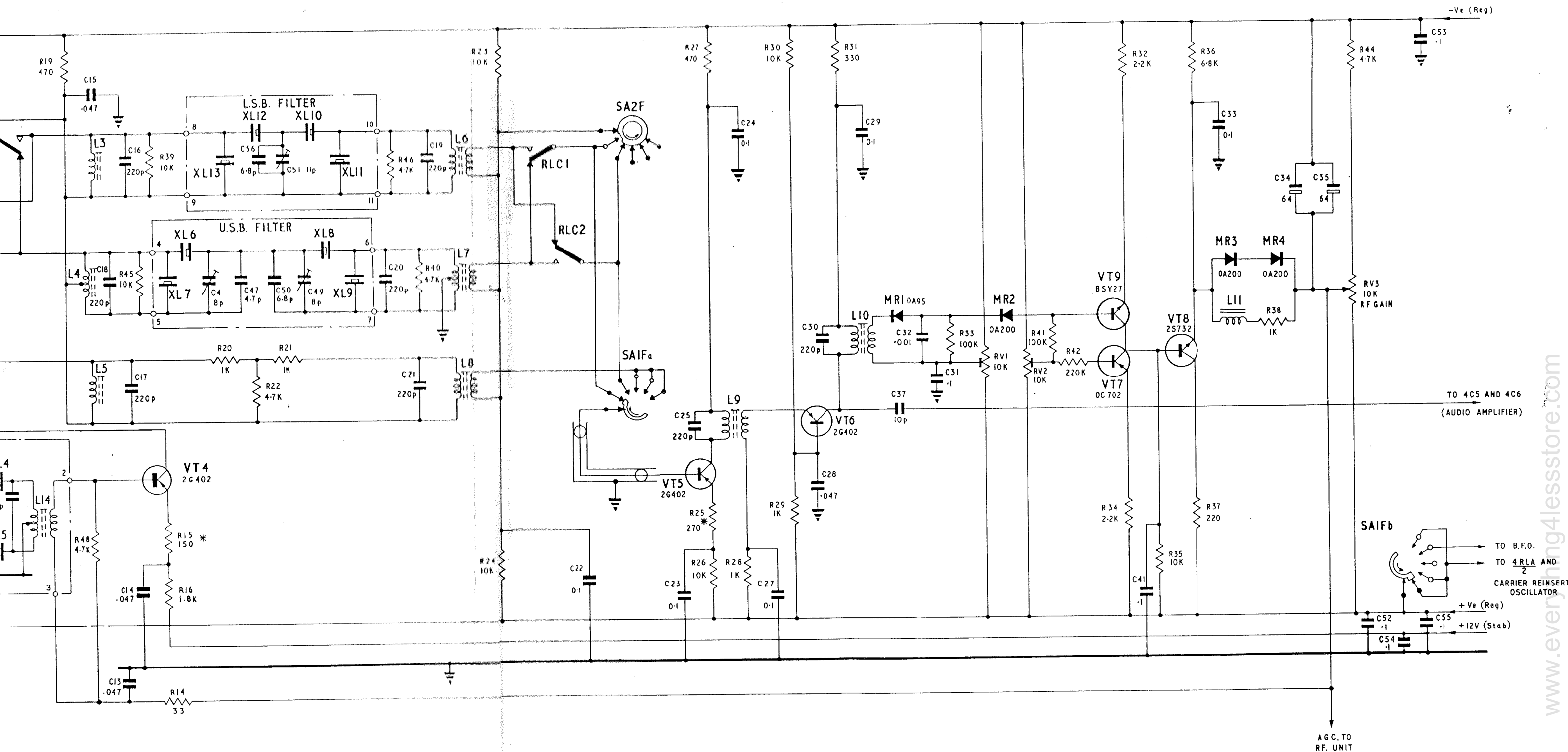


Fig.7

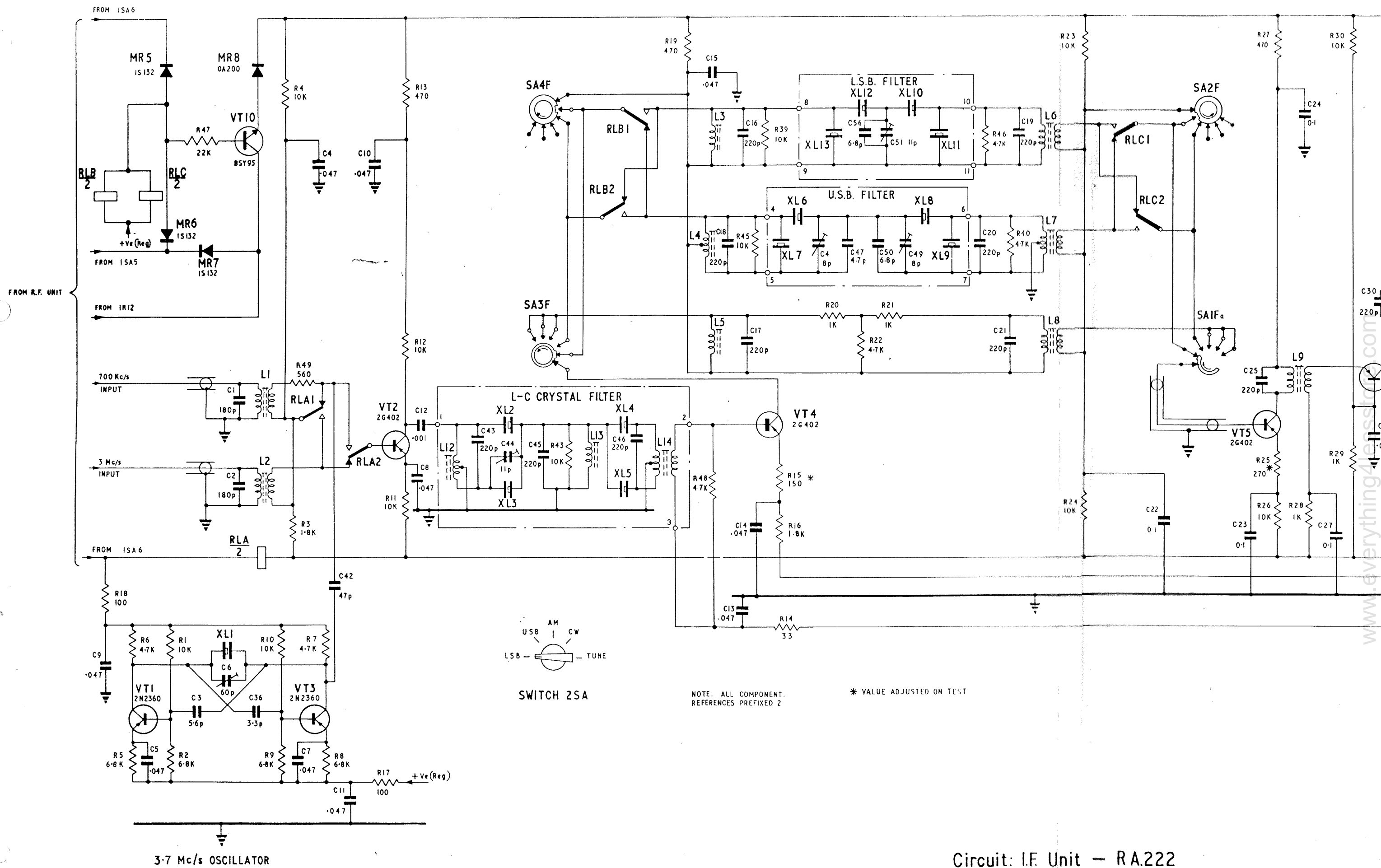


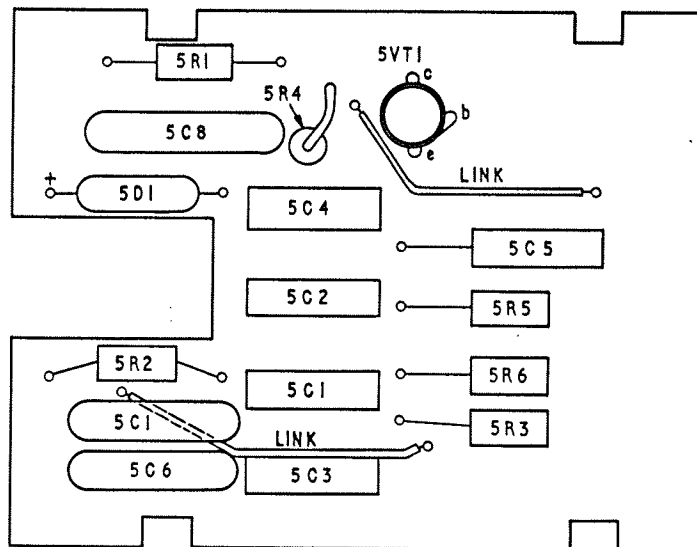
NOTE. ALL COMPONENT.
REFERENCES PREFIXED 2

* VALUE ADJUSTED ON TEST

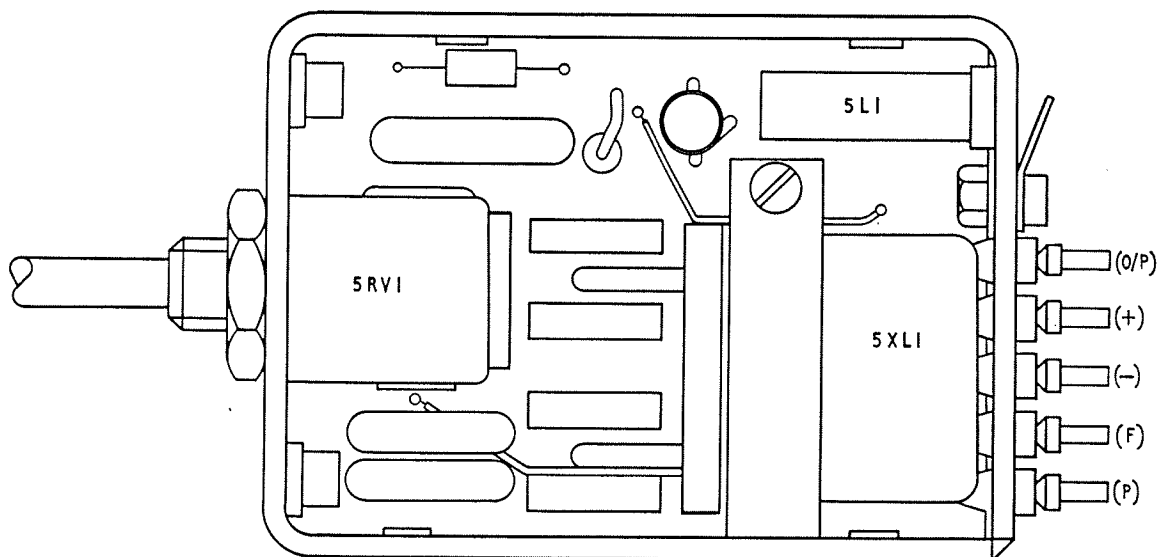
Circuit: I.F. Unit - RA.222

Fig.8





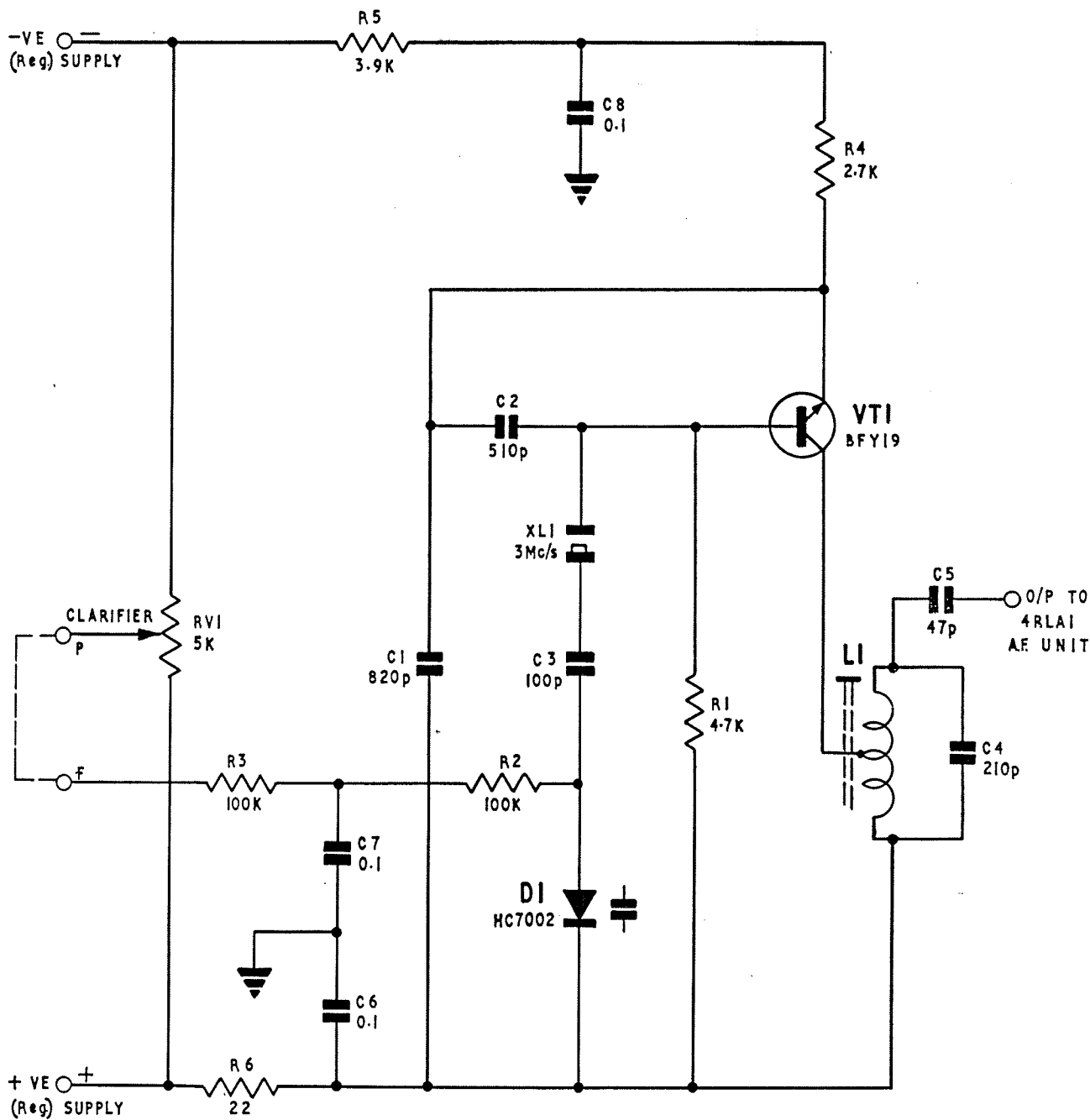
Component board



Component Layout 3Mc/s Carrier
Re-insertion Oscillator

Fig. 9

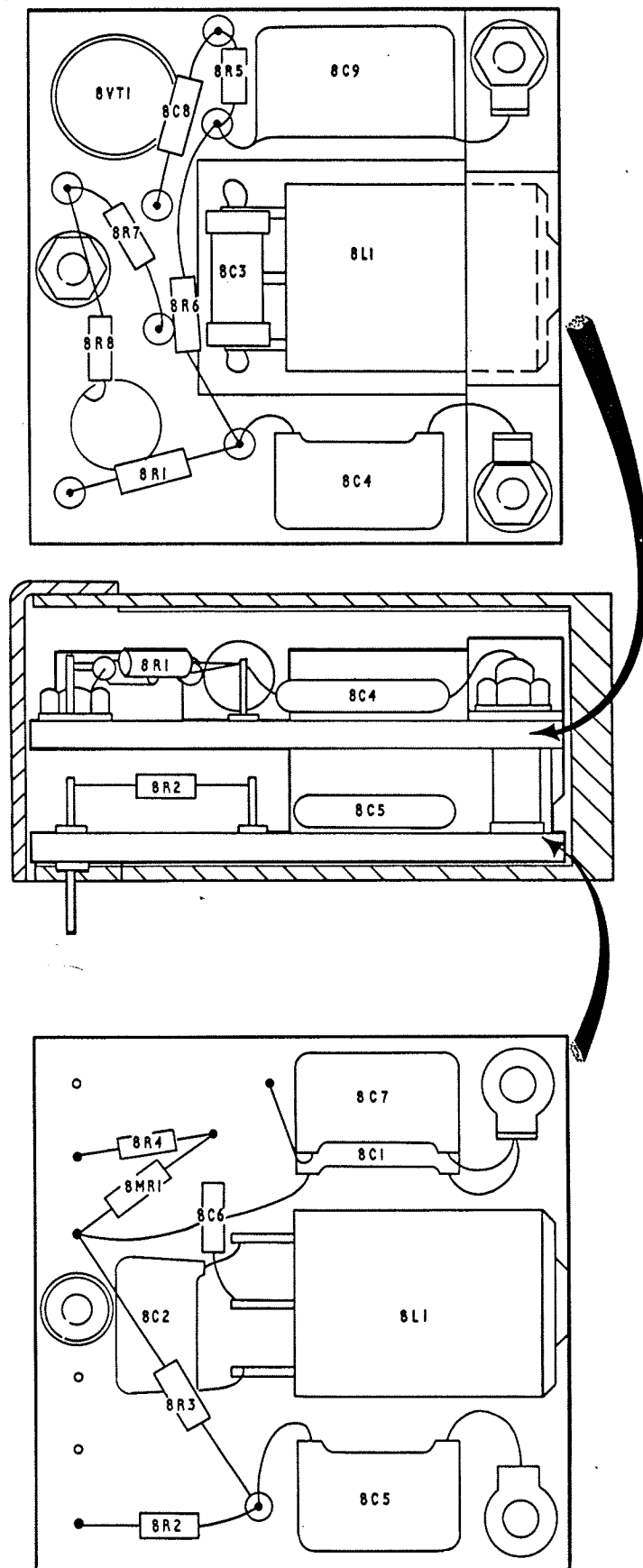
157/B34



157/B35	AC35465
3	

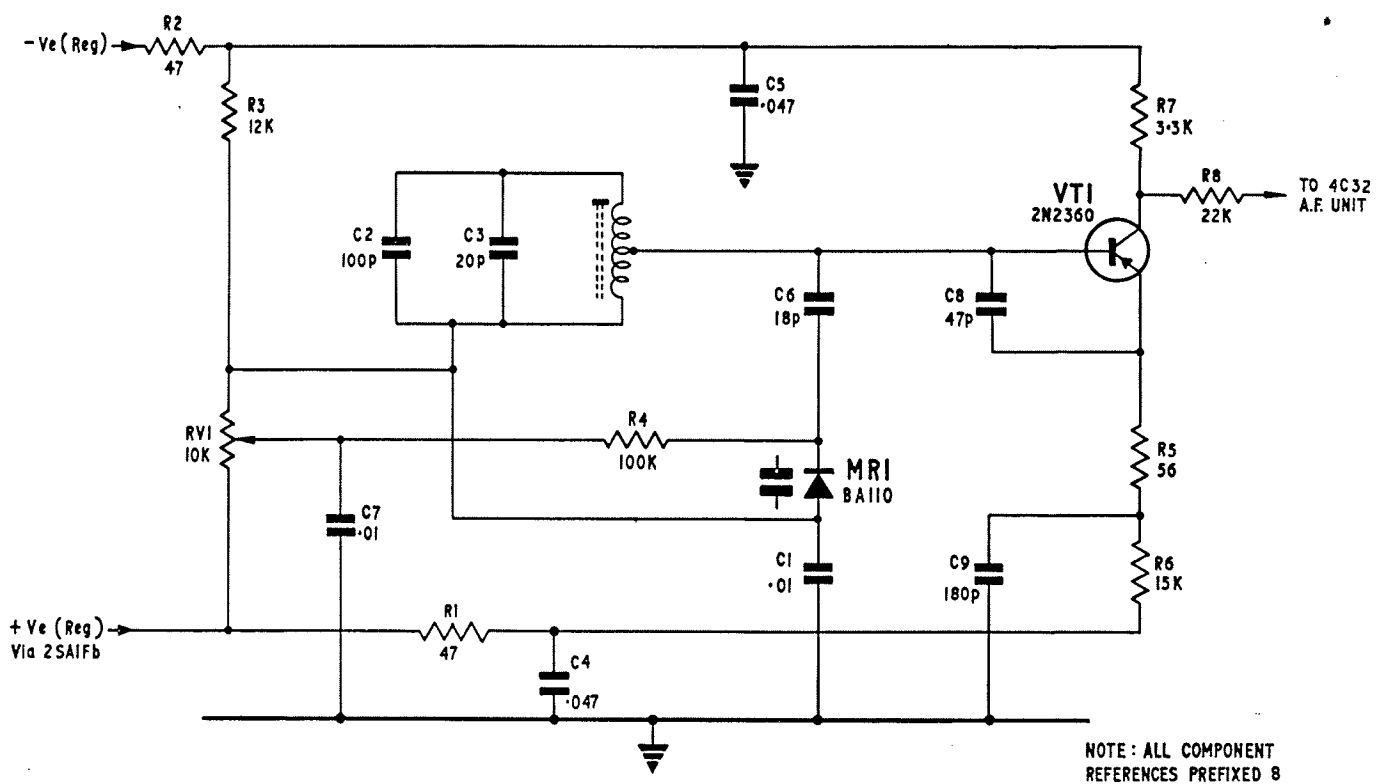
Circuit: 3Mc/s Carrier
Re-insertion Oscillator

Fig. 10



Component Layout : B.F.O. Unit

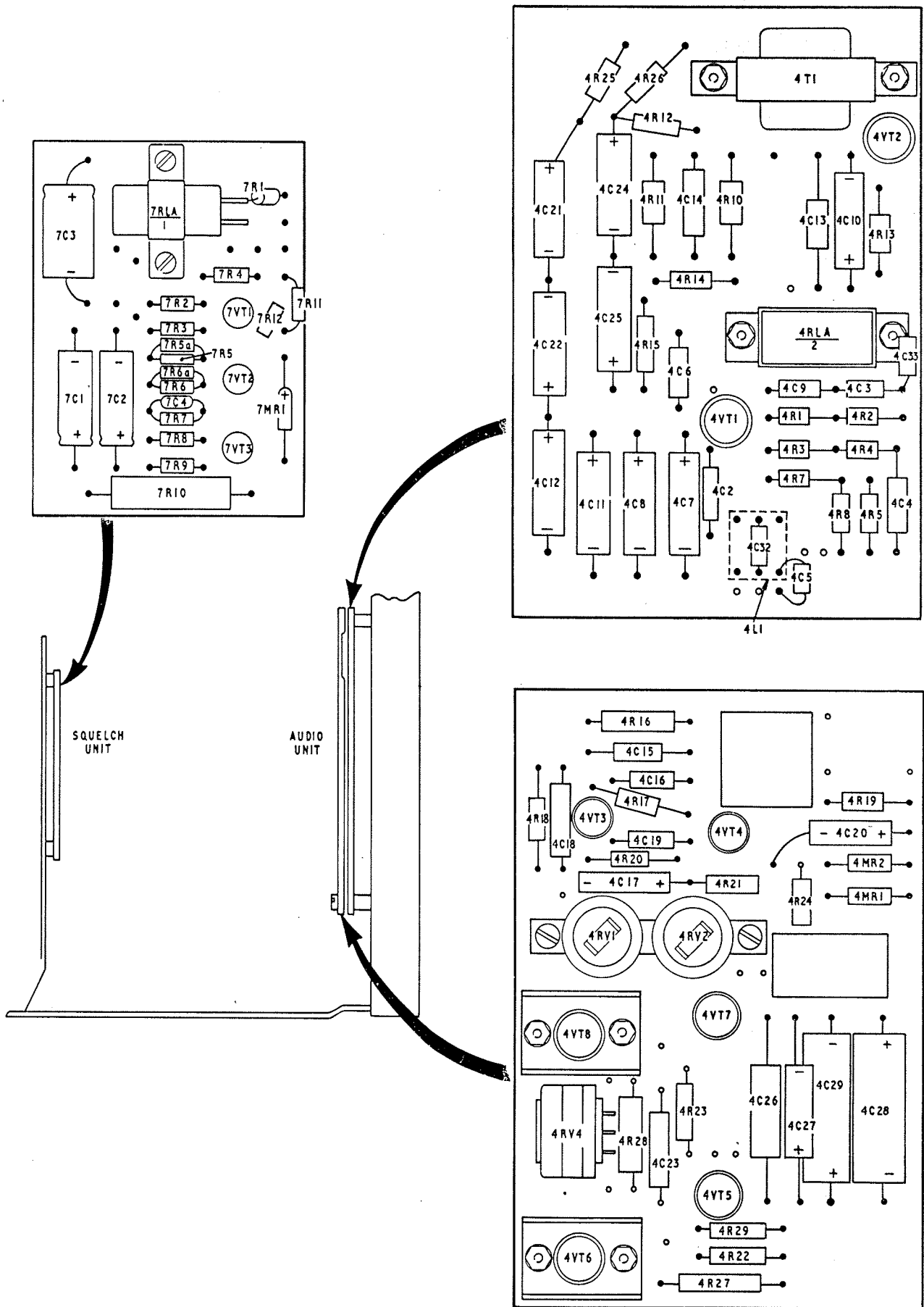
Fig.II

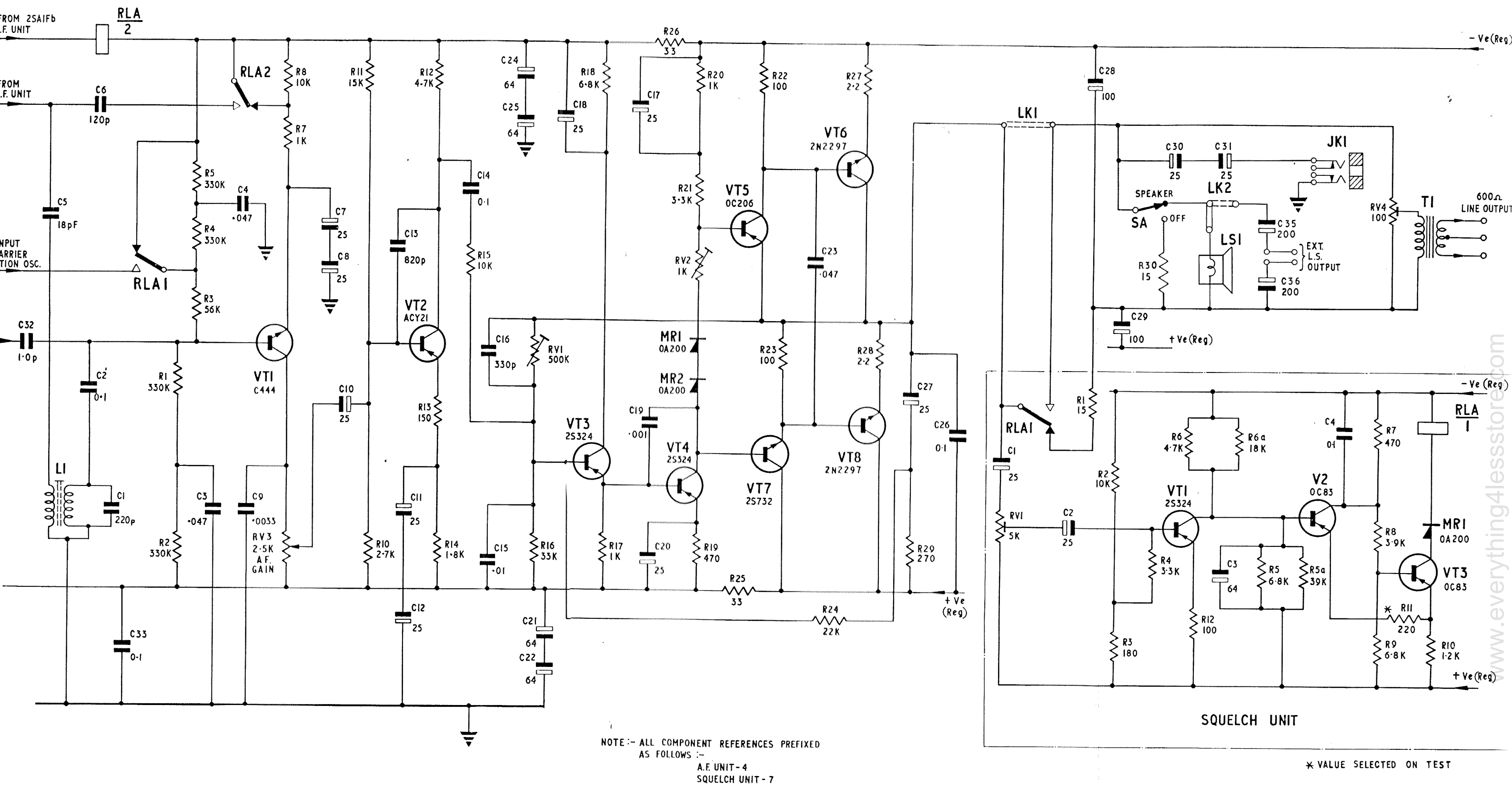


157/12

Circuit: B.F.O — RA.222

Fig. 12

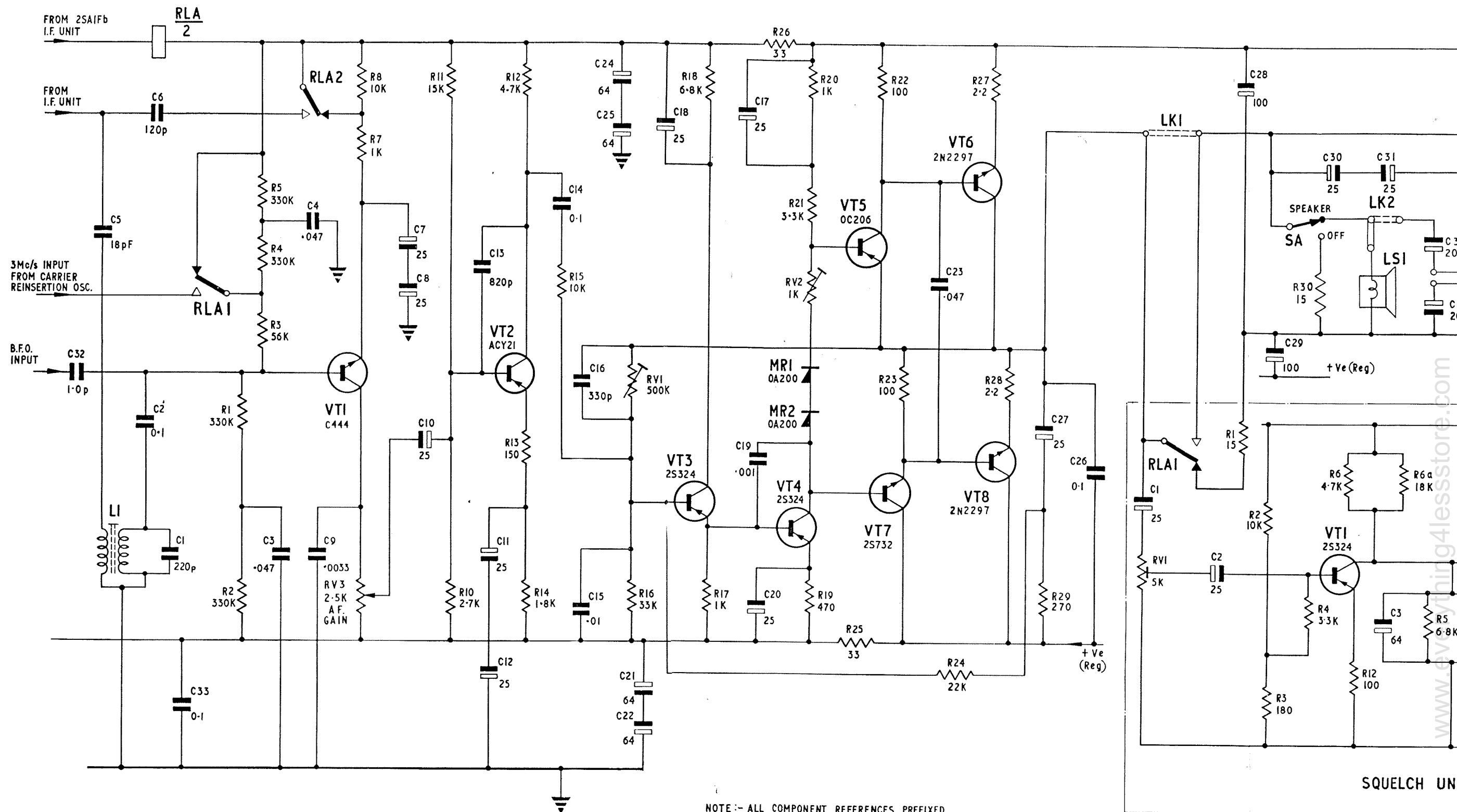




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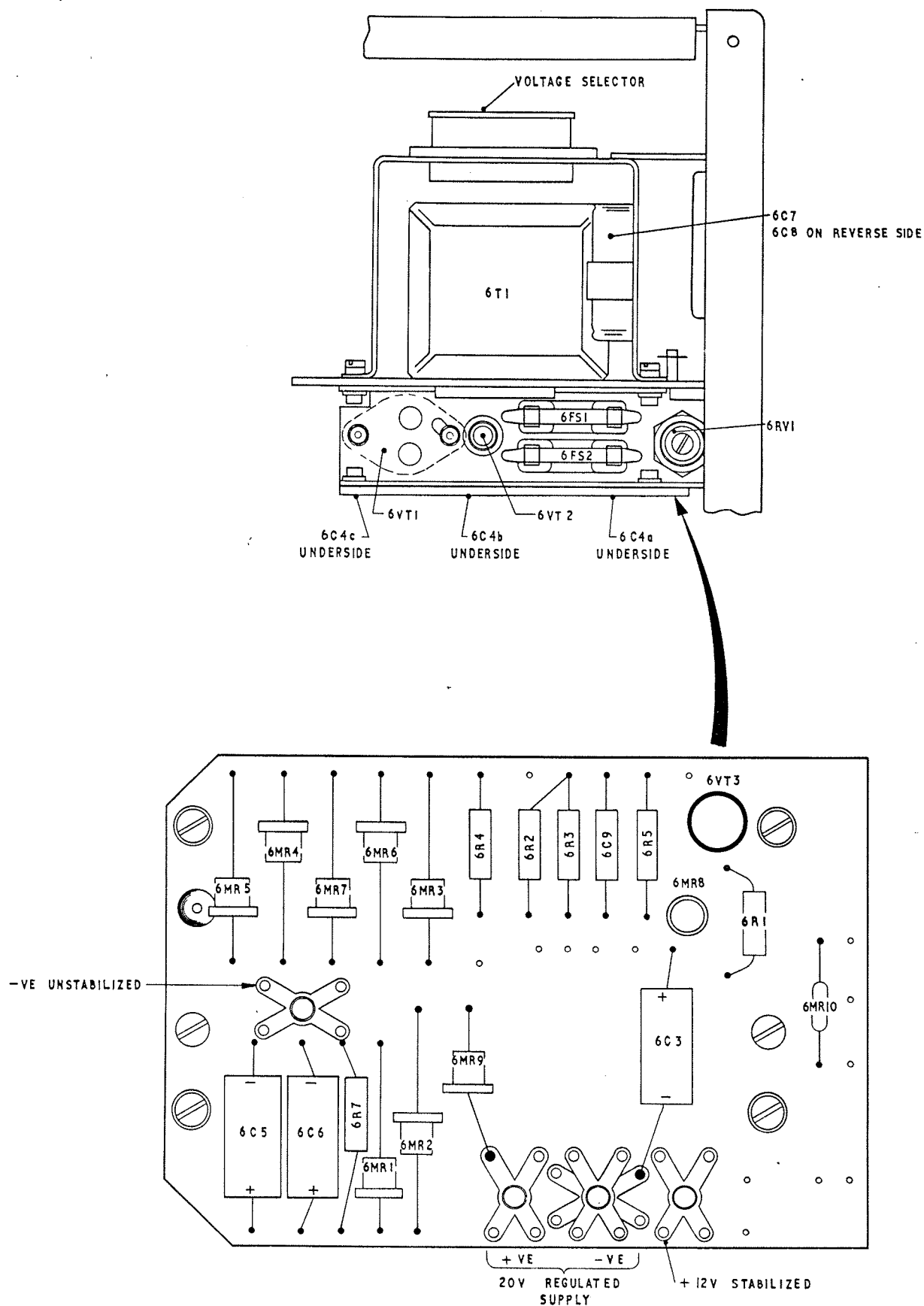
Circuit: Audio Amplifier and Squelch Units - RA222

Fig. 14



157/B14 CC24390

Circuit: Audio Amplifier and Squelch Units - RA222



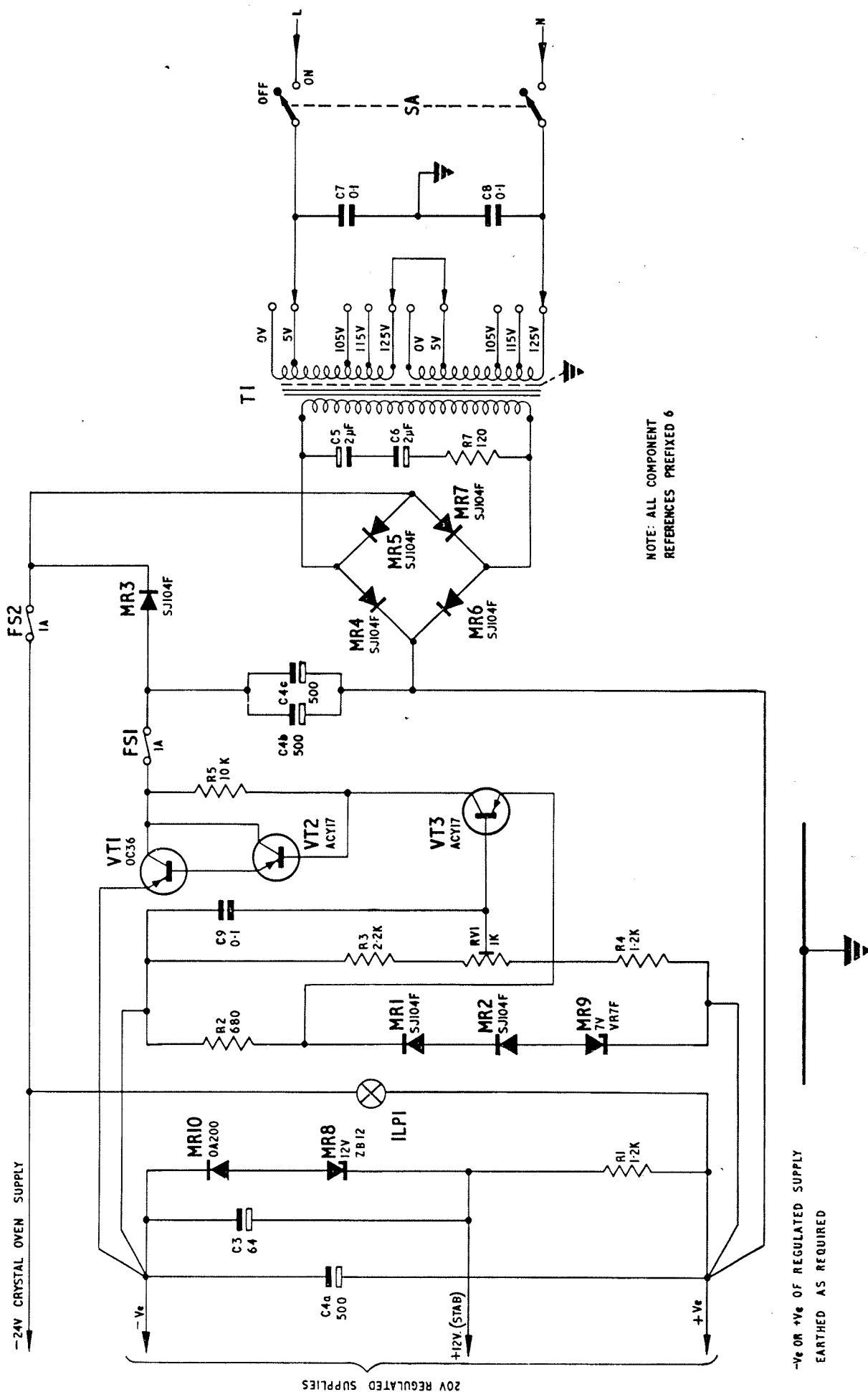
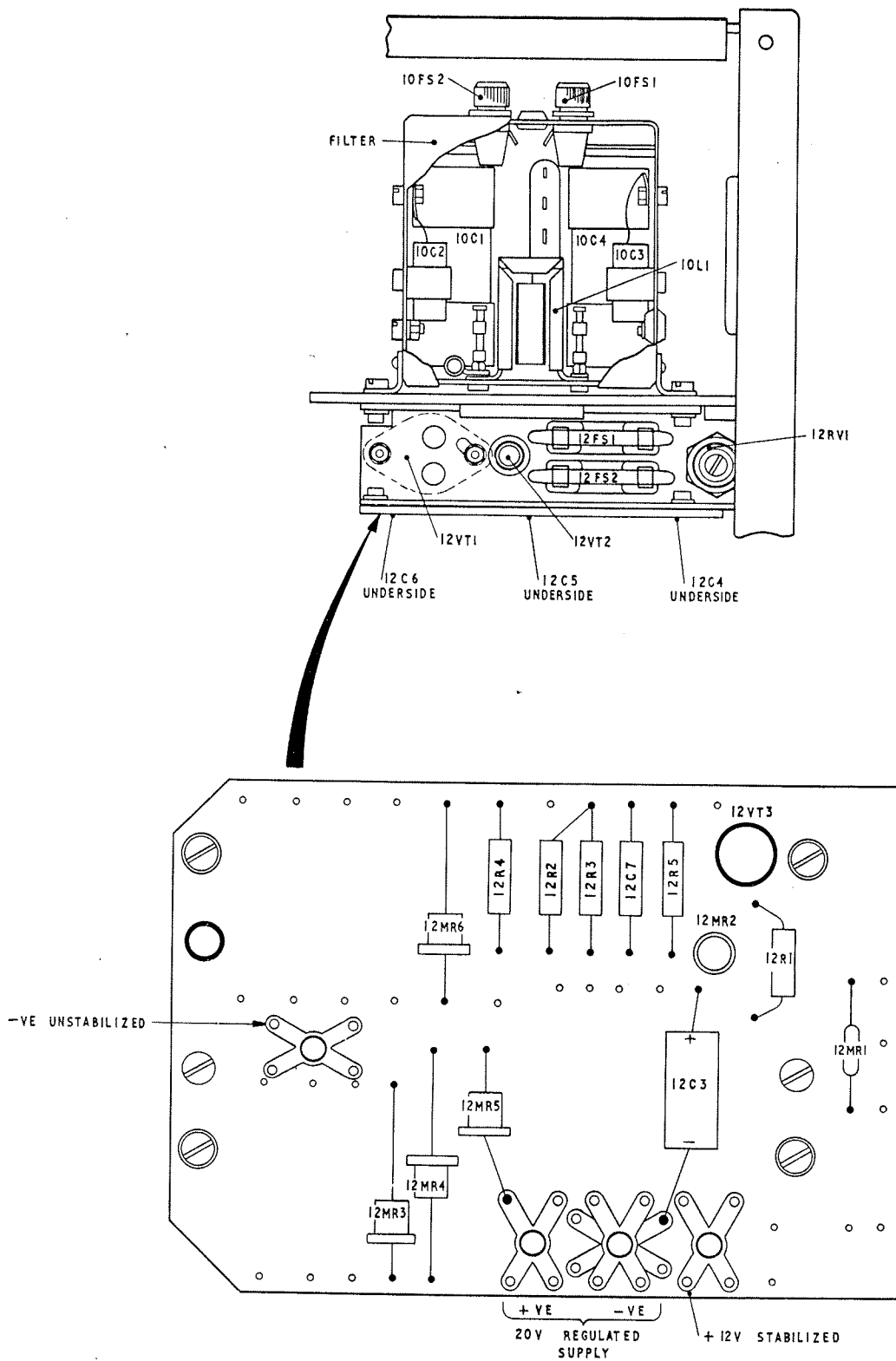
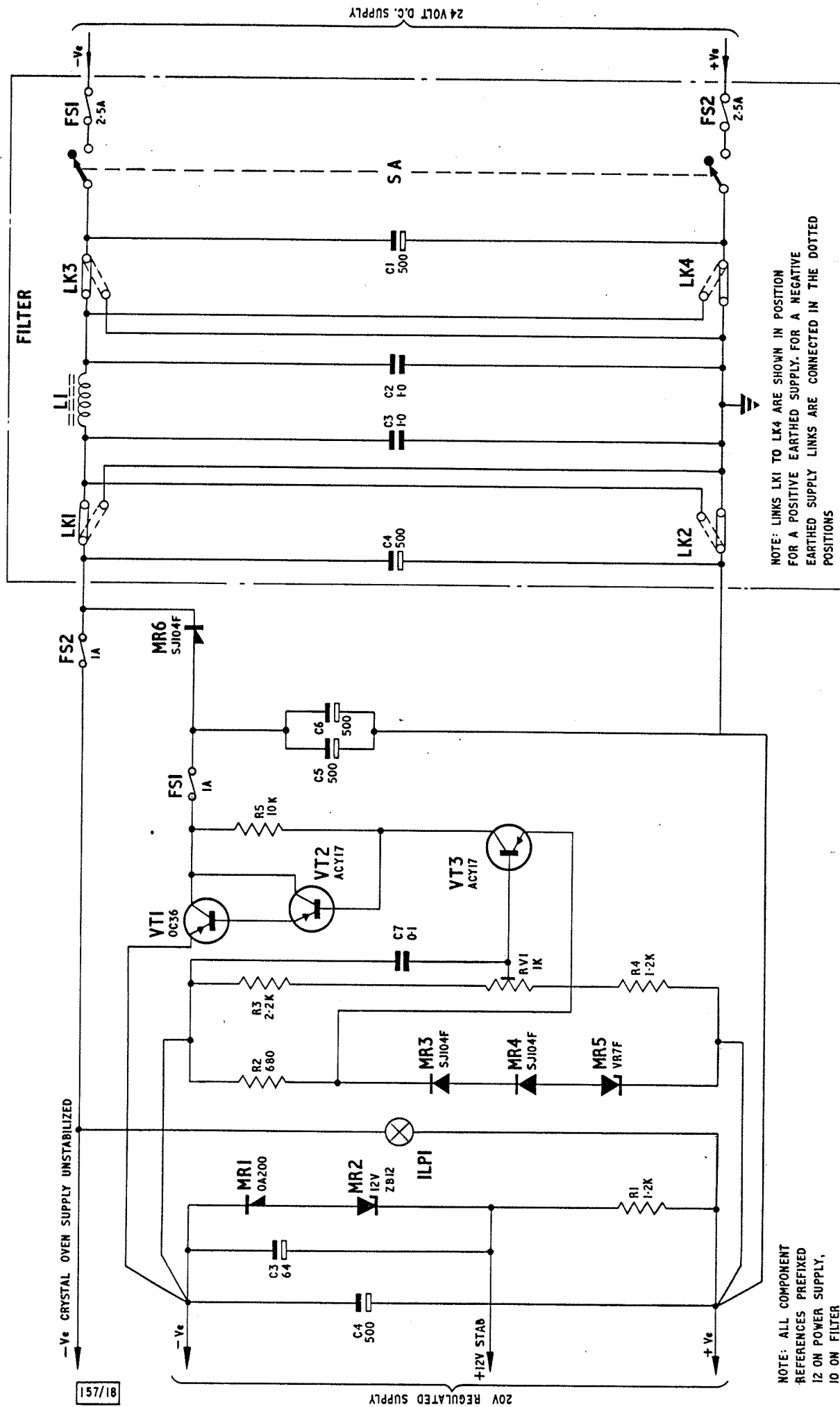


Fig.16



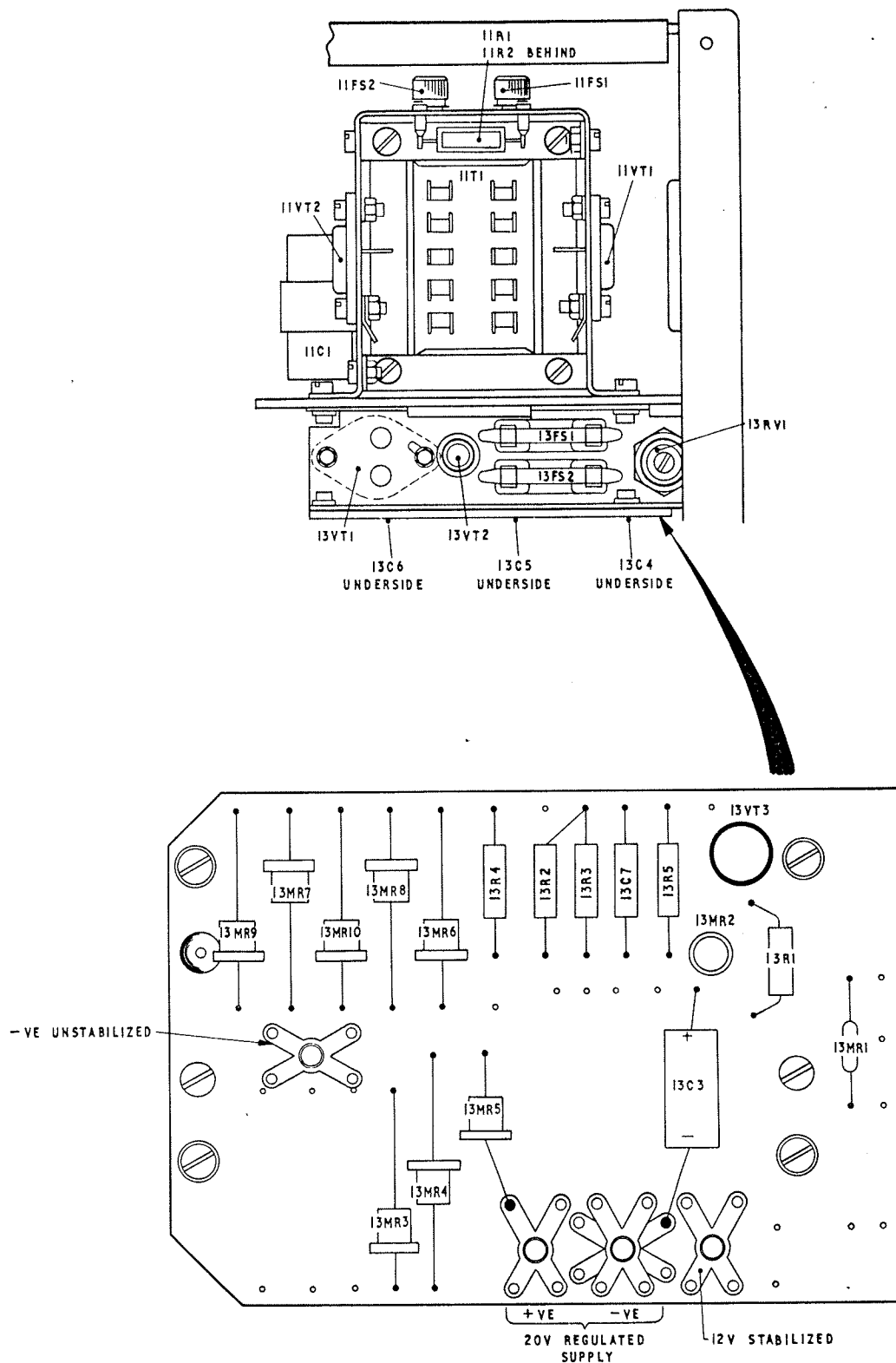
Component Layout: 24V. DC. Power Unit

Fig.17



Circuit: 24V. D.C. Power Supply and Filter. — RA.222

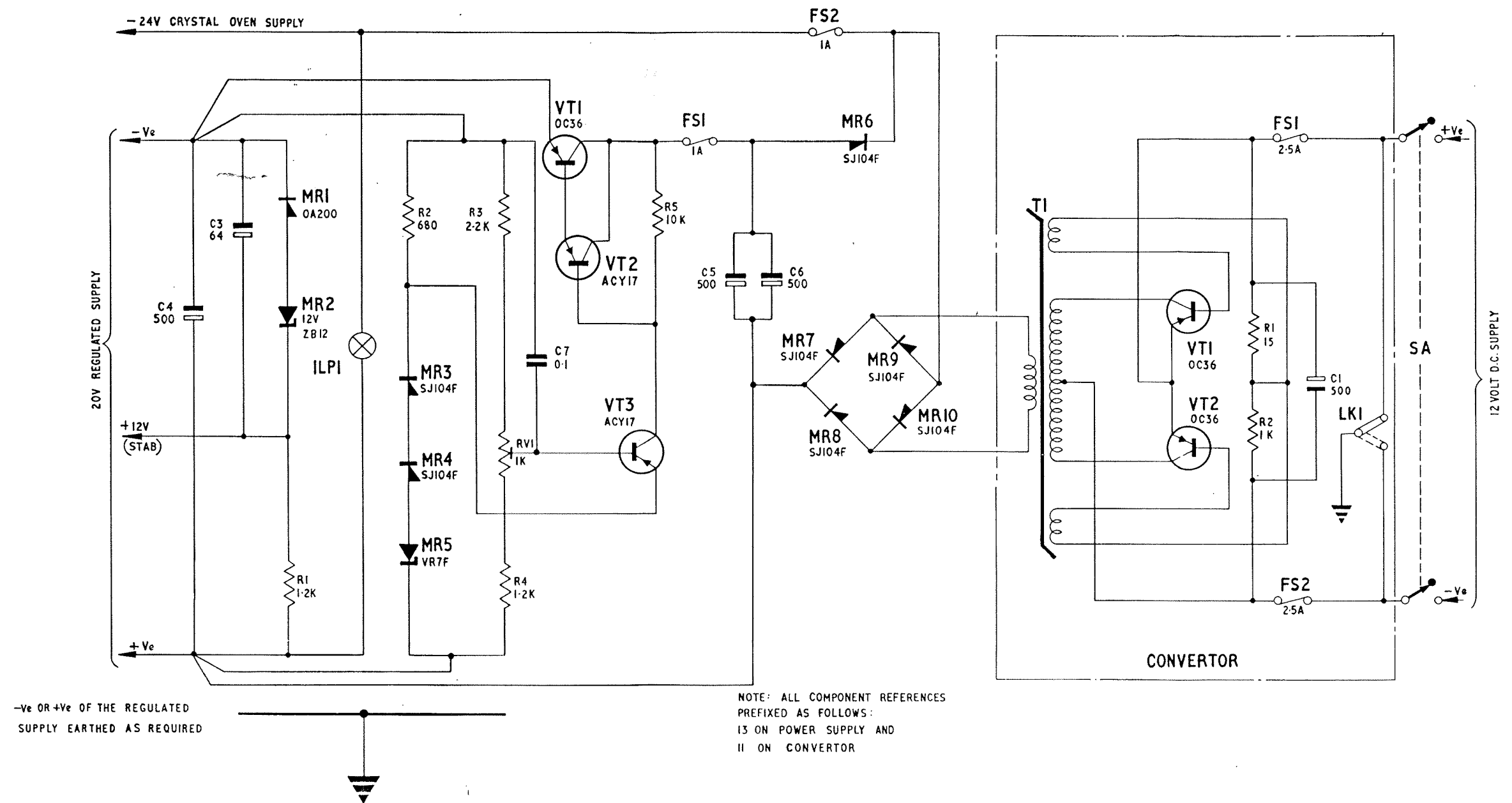
Fig.18



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Component Layout: 12V. DC. Power Unit

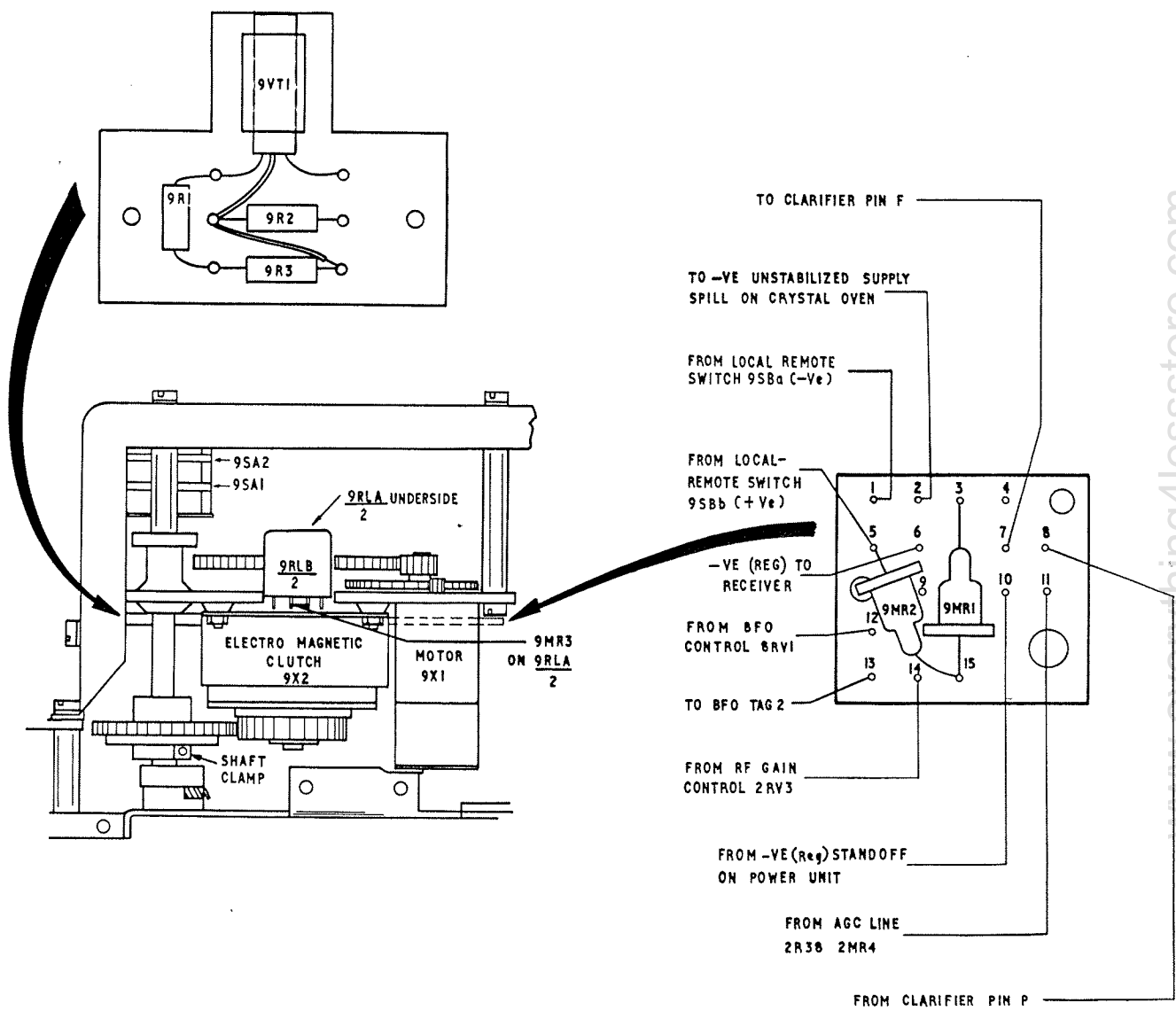
Fig.19



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Circuit: 12V D.C. Power Supply and Convertor - RA.222

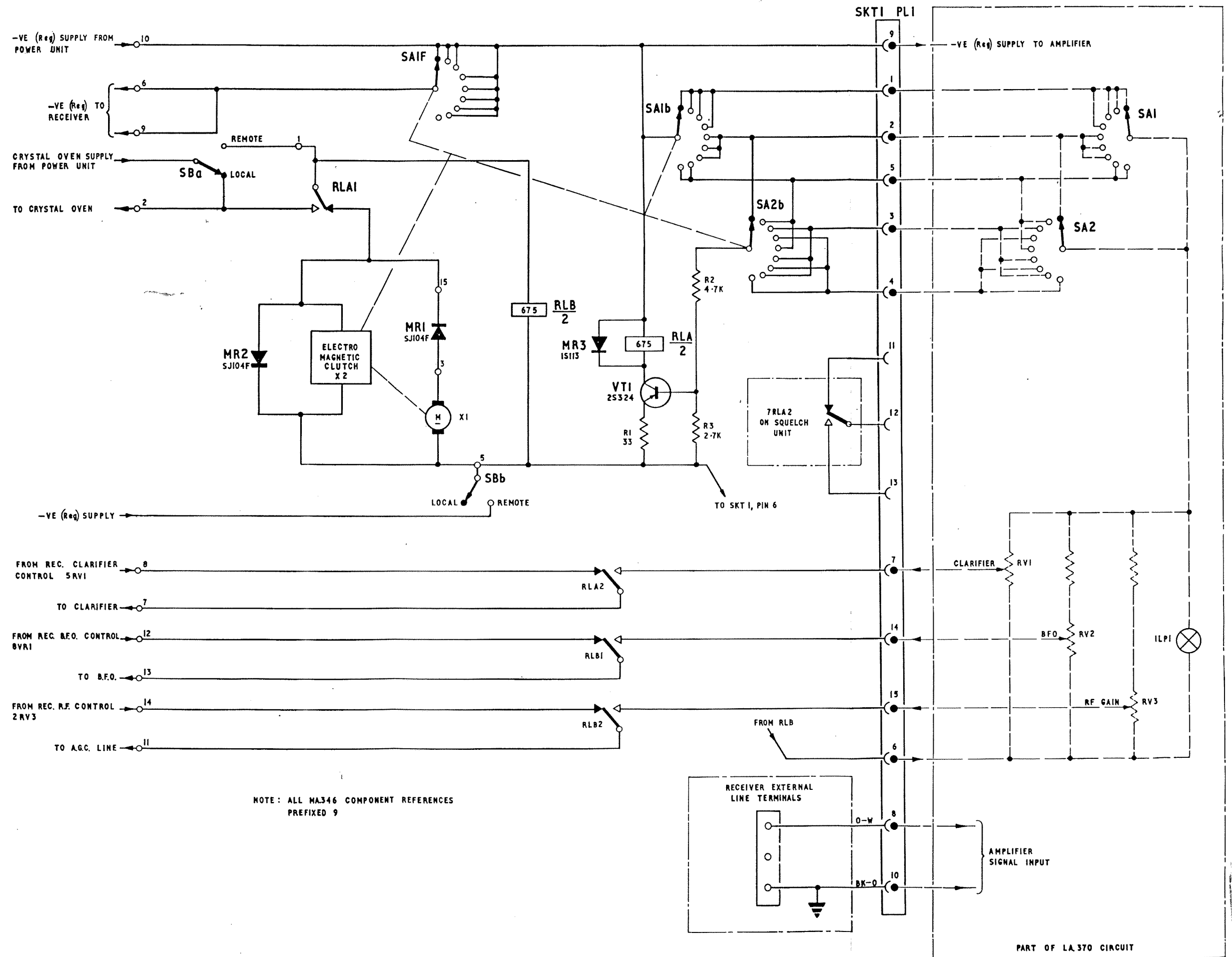
Fig.20



Component Layout: Extended Control
Receiver Module MA346

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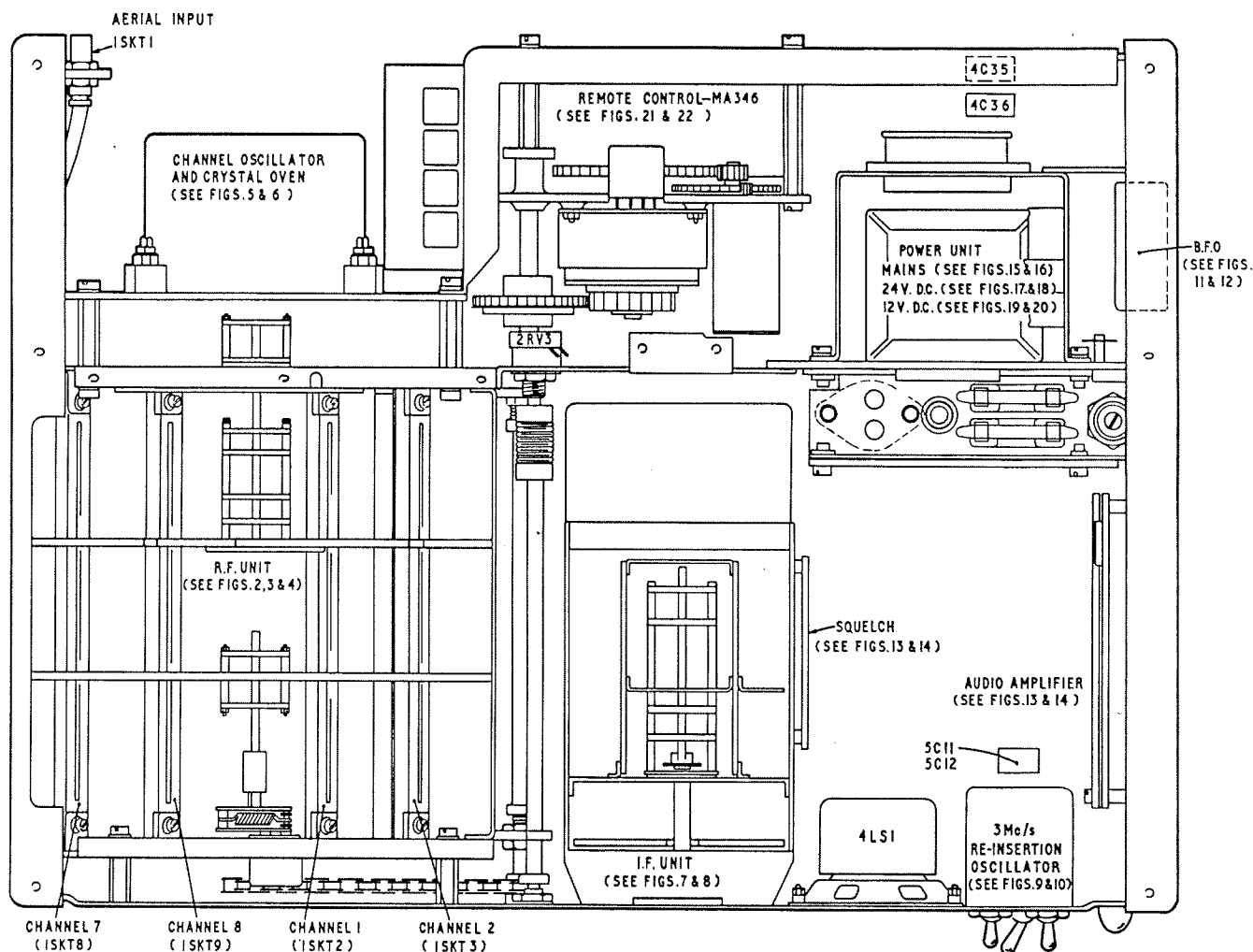
Fig21



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Circuit: Extended Control Receiver Module-MA346

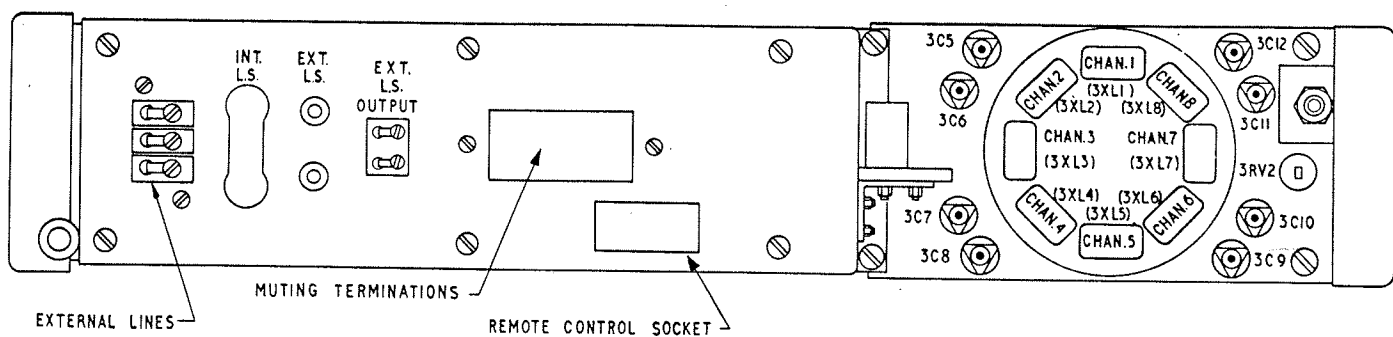
Fig. 22



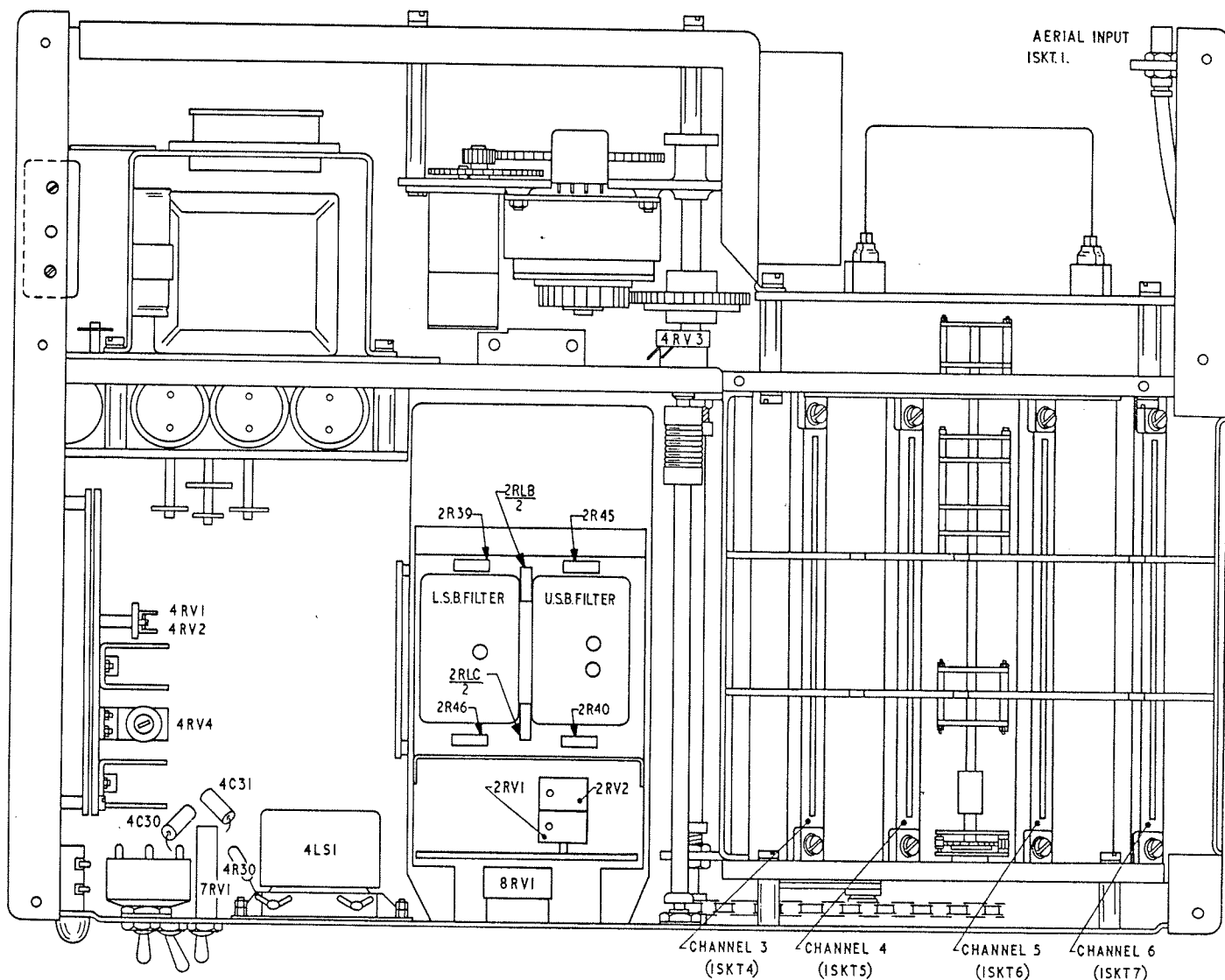
157/b23

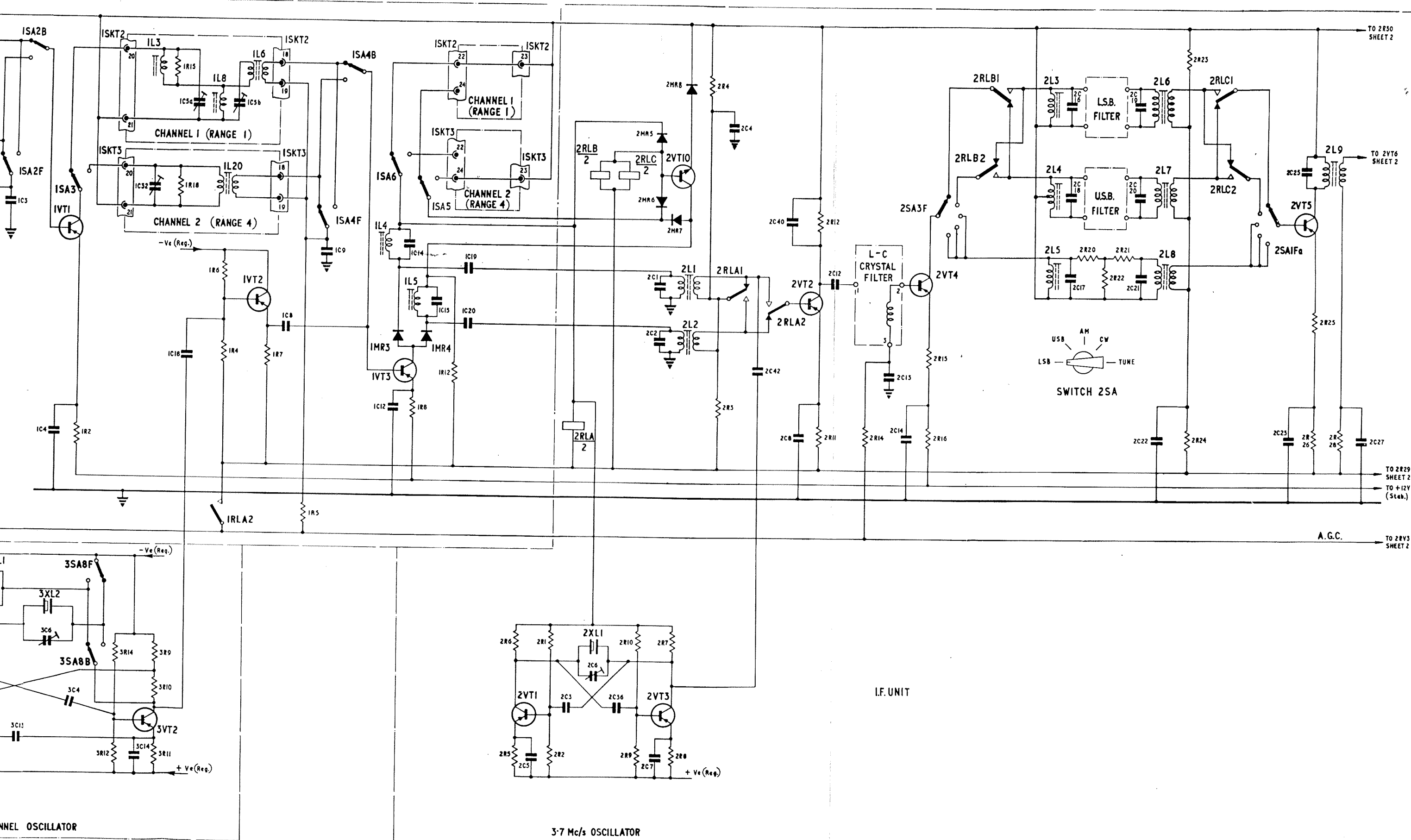
Chassis : Top View - RA.222

Fig.23



Rear View



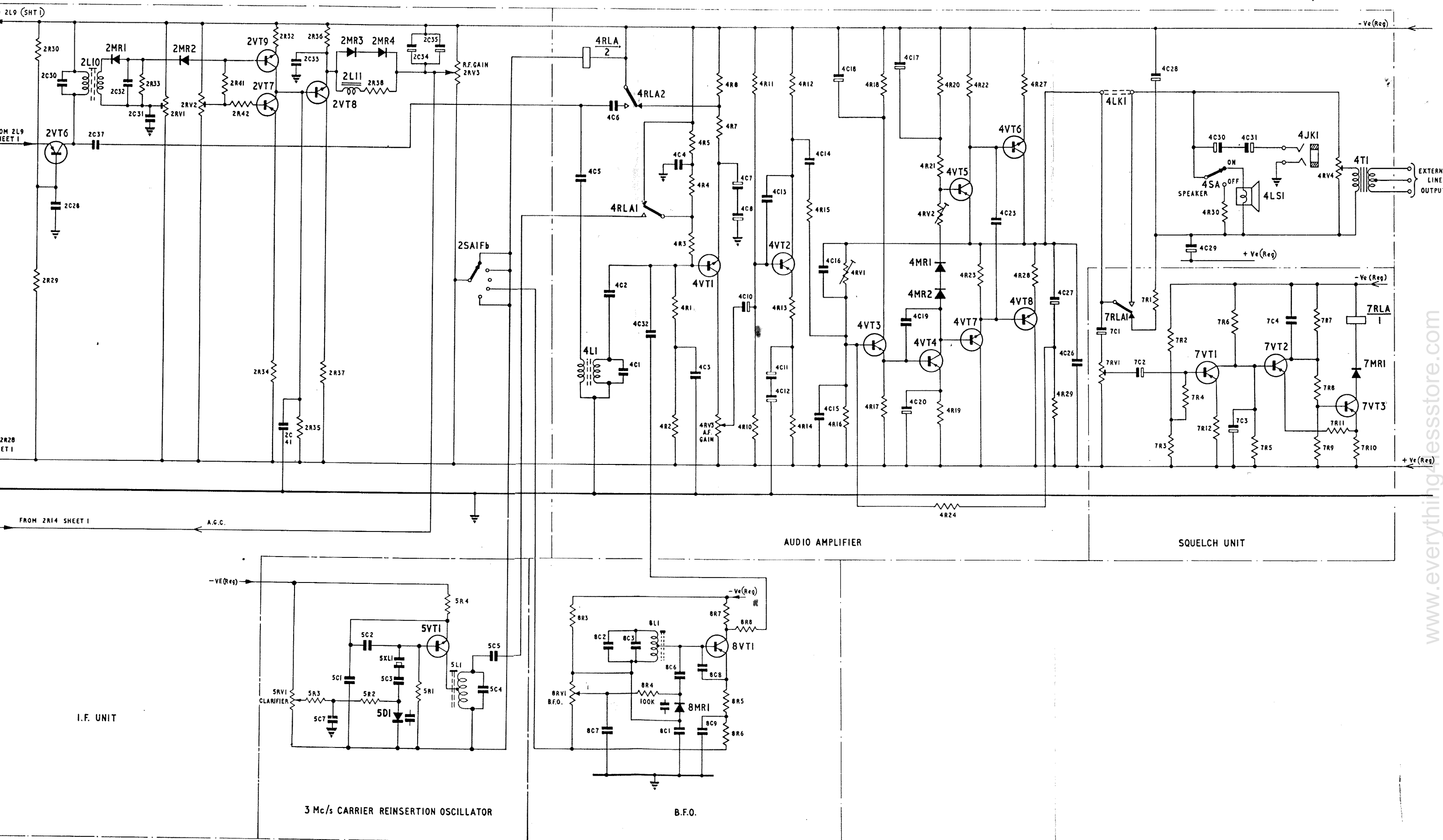


Simplified Overall Circuit :- RA.222 SHT.1

Fig.25a

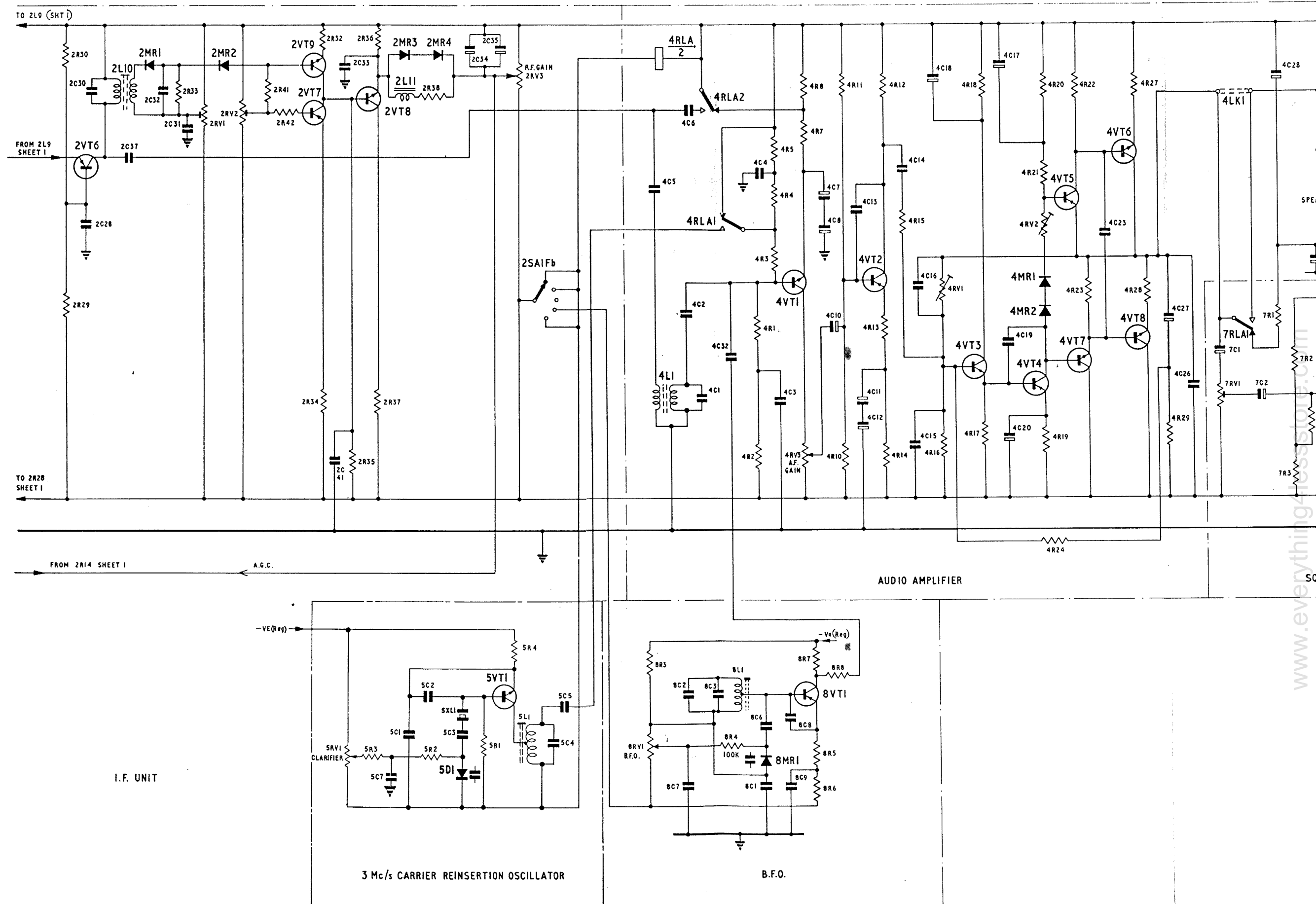


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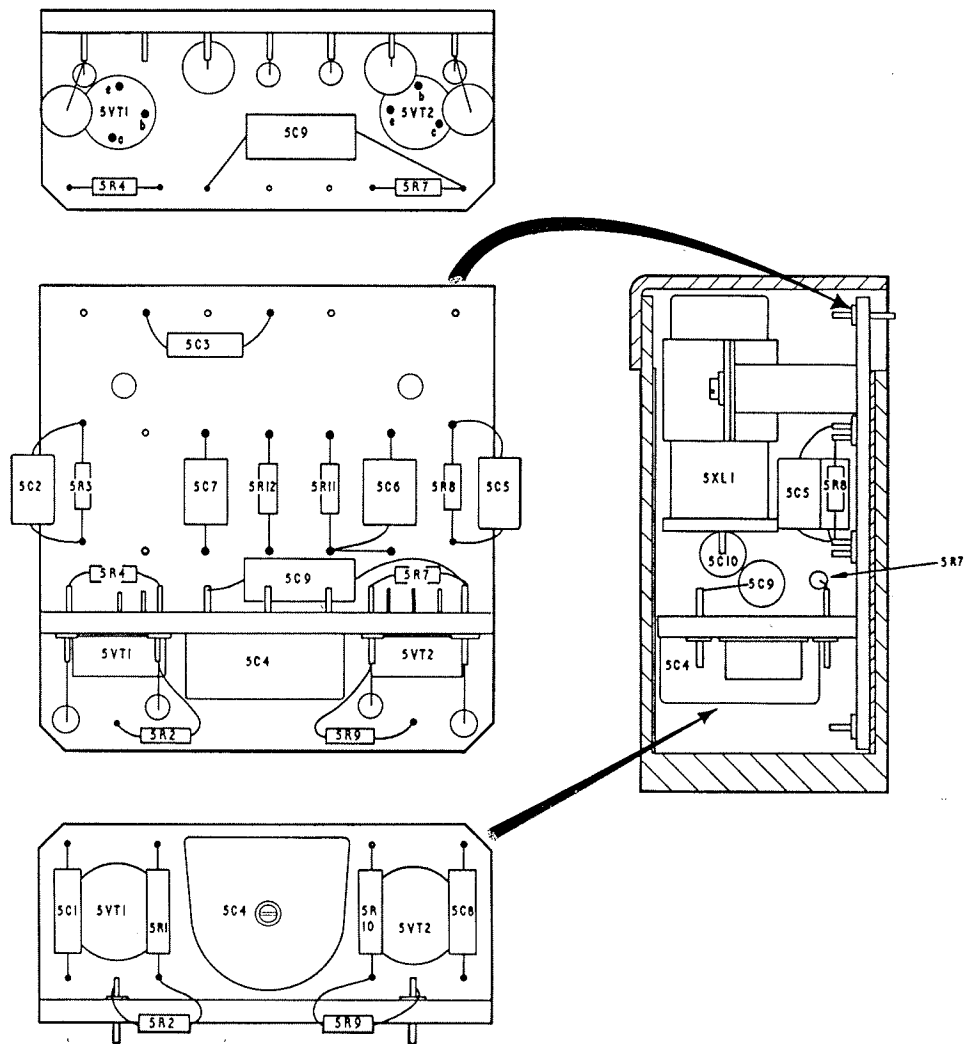
Simplified Overall Circuit :- RA.222 SHT.2

Fig.25b



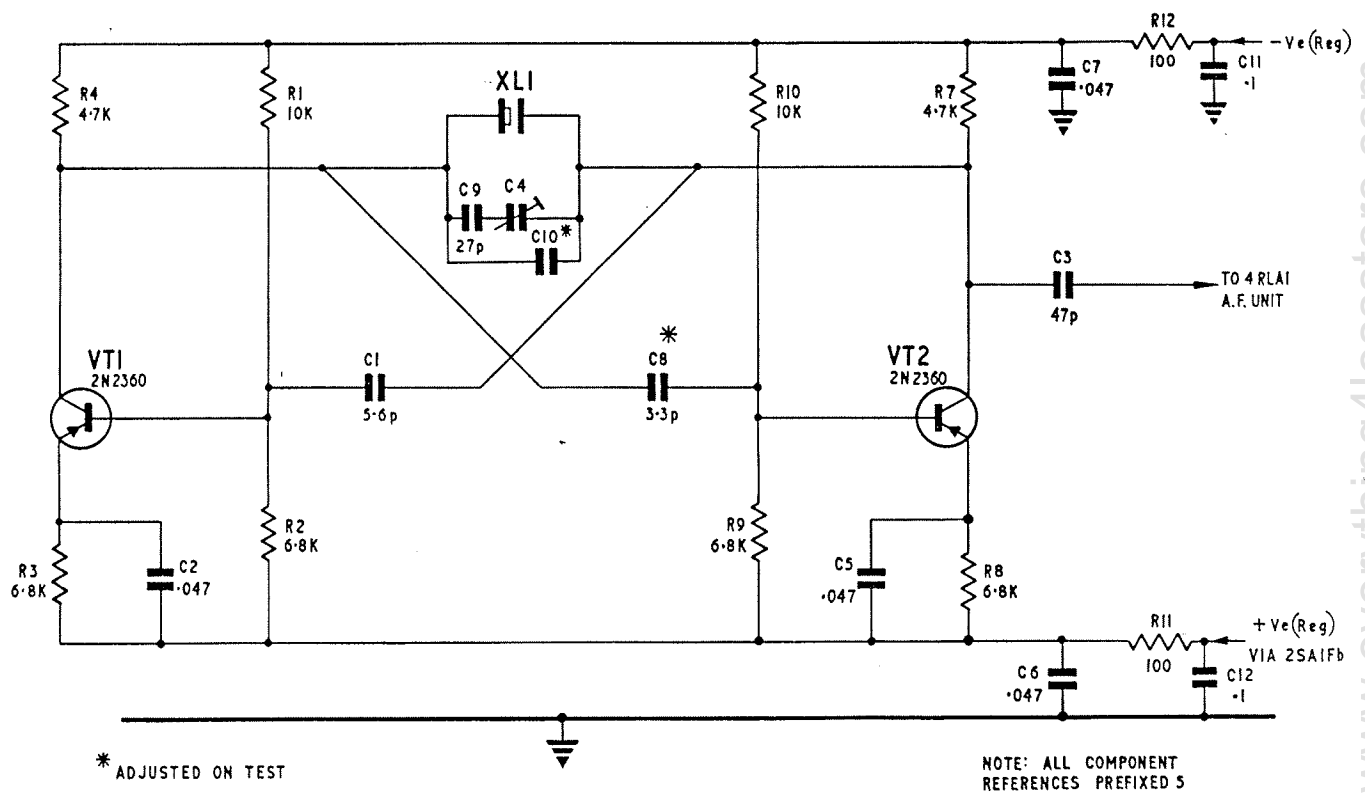
157/025b

Simplified Overall Circuit :- RA.222 SHT.2



Component Layout : 3 Mc/s Carrier Re-Insertion Oscillator Fig. 26
(Preset Version)

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Circuit: Carrier Reinsertion—RA.222
(Preset Version)

Fig. 27